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Environmental Concentrations of Hexachlorobenzene in Atlantic Canada

IWD-AR-WQB-91-170

Canada

INLAND WATERS DIRECTORATE
ATLANTIC REGION
WATER QUALITY BRANCH
MONCTON, NEW BRUNSWICK

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Executive Summary

In June of 1988, the Parliament of Canada proclaimed the Canadian Environmental Protection Act (CEPA).

A great deal of knowledge about toxic chemicals is needed to successfully implement CEPA. Their use, toxicity, fate in the environment and effects on wildlife are examples of what needs to be known to assess the full impact of toxic chemicals on the biosphere.

In order to focus the efforts of government agencies involved in implementing CEPA, a Priority Substances List (PSL) has been created. On it can be found the name of substances that are suspected of having adverse environmental effects and should thus be of immediate concern.

In response to the need for knowledge about toxic substances mentioned on the PSL, the Water Quality Branch/Atlantic Region has undertaken a comprehensive compilation of it's own data banks and the preparation of summary reports.

Hexachlorobenzene is a toxic substance appearing in Group 1 of the PSL. This report summarizes the information the Water Quality Branch/Atlantic Region has on its concentration in Atlantic Canada's environment.

Abstract

This report was initiated in support of the new Canadian Environmental Protection Act (CEPA). It summarizes 10 years of hexachlorobenzene data generated by the Water Quality Branch in the Atlantic Region from 1979 to 1989.

Hexachlorobenzene analysis were performed on more than 1500 samples encompassing streams, lakes, estuaries, ground water wells, precipitation, sediments and biota.

The great majority of samples (99%) was reported as having HCB concentrations less than the applicable detection limits; 0.002 ug/L for most water samples, and 0.0002, 0.002 or 0.004 mg/kg for biota and sediment samples.

Only six water samples, analyzed in 1980, showed positive HCB values ranging from 0.0005 to 0.0022 ug/L. They were taken from three sites: Charlottetown Harbour (PEI), Annapolis River (NS) and Liverpool Bay (NS). All were below 0.0065 ug/L, the guideline value for aquatic life, and no HCB was found in any water samples after 1980.

All 45 gull and cormorant egg samples collected and analyzed in 1979 by the Environmental Protection Service of Environment Canada showed HCB concentrations ranging from 0.0007 to 0.062 mg/kg. This clearly showed that HCB can bioaccumulate and move up the food chain.

Only 12 sediment samples analyzed in 1980-82 (seven of them replicates) showed positive HCB concentrations, ranging from 0.0004 to 0.010 mg/kg. They were taken from four sites: Annapolis River (NS), Restigouche River (NB), Scales Pond (PEI) and Deer Lake (Nfld.). There are presently no guidelines for HCB in sediments, but the low number of samples showing positive HCB concentrations and the concentrations encountered suggested a low level of contamination.

Based on the data presented in this report, it was concluded that the presence of hexachlorobenzene in Atlantic Canada's environment seems to be limited and mostly localized to sites where some industrial activities occur, and that hexachlorobenzene is not, at the moment, a problem compound in Atlantic Canada's environment.

Sommaire

Ce document a été rédigé à l'appui de la Loi Canadienne pour la Protection de l'Environnement (LCPE). Il résume les données sur l'hexachlorobenzène (HCB) recueillies depuis 10 ans (1979-1989) par la Direction de la Qualité des Eaux pour la région de l'Atlantique.

Plus de 1500 échantillons provenant de cours d'eau, de lacs, d'estuaires, d'eaux souterraines, de précipitations, de sédiments et de biotes ont été analysés.

Les concentrations d'HCB dans les échantillons étaient, dans 99% des cas, inférieures aux seuils de détection applicables: 0.002 ug/L pour la plupart des échantillons d'eau, et 0.0002, 0.002 ou 0.004 mg/kg pour les échantillons de sédiments et de biotes.

L'hexachlorobenzène a été détecté dans seulement six échantillons d'eau, analysés en 1980, à des concentrations variant de 0.0005 à 0.0022 ug/L. Les échantillons provenaient de trois sites: le Havre de Charlottetown (I.-P.-É.), la Rivière Annapolis (N.-É.) et la Baie de Liverpool (N.-É.). Les concentrations étaient toutes inférieures à 0.0065 ug/L, l'objectif pour la faune aquatique, et l'HCB n'a été retrouvé dans aucun autre échantillon d'eau après 1980.

Des concentrations d'HCB, variant de 0.0007 à 0.062 mg/kg, ont été trouvées dans les 45 oeufs de goélands et de cormorans analysés en 1979 par le Service de la Protection de l'Environnement (Environnement Canada). Ceci a démontré clairement que l'HCB peut subir une bioaccumulation et progresser dans la chaîne alimentaire.

L'HCB a été retrouvé dans seulement 12 échantillons de sédiments (dont 7 réplicats), analysés entre 1980 et 1982, à des concentrations variant de 0.0004 à 0.010 mg/kg. Les échantillons provenaient de quatre sites: la Rivière Annapolis (N.-É.), la Rivière Restigouche (N.-B.), Scales Pond (I.-P.-É.) et du Lac Deer (T.-N.). Il n'y a pas à l'heure actuelle d'objectif visant la concentration d'HCB dans les sédiments, mais le nombre restreint d'échantillons dans lesquels l'HCB a été détecté ainsi que les faibles concentrations retrouvées suggèrent une faible contamination des sédiments.

Il a été conclu, à partir des données présentées dans ce rapport, que la présence de l'hexachlorobenzène dans l'environnement des provinces de l'Atlantique semble être limitée et localisée principalement à des zones industrielles, et que l'HCB n'est pas à l'heure actuelle un composé problème dans les provinces de l'Atlantique.

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Environmental Concentrations of Hexachlorobenzene in Atlantic Canada

1. Introduction

In June of 1988, the Parliament of Canada proclaimed a new law, the Canadian Environmental Protection Act (CEPA). It's purpose is to better protect Canadians from pollution by reinforcing the government's abilities to monitor and control toxic chemicals throughout their life cycle. This has often been referred to as the "cradle to grave" approach, meaning that toxic chemicals must be controlled from their very beginning, at the development stage, throughout their manufacturing, storage, transportation, use, disposal and fate in the environment.

A great deal of knowledge about toxic chemicals is thus needed to successfully implement CEPA. Their use, toxicity, fate in the environment and effects on wildlife are examples of what needs to be known to assess the full impact of toxic chemicals on the biosphere.

In order to focus the efforts of government agencies involved in implementing CEPA, a Priority Substances List (PSL) has been created. On it can be found the name of substances that are suspected of having adverse environmental effects and should thus be of immediate concern.

In response to the need for knowledge about toxic substances mentioned on the PSL, the Water Quality Branch-Atlantic Region (WQB-AR) has undertaken a comprehensive compilation of it's own data banks and the preparation of summary reports.

Hexachlorobenzene is a toxic substance appearing on the PSL. This report summarizes the information the WQB-AR has on it's concentration in Atlantic Canada's environment.

1.1 Hexachlorobenzene

Hexachlorobenzene (HCB) is a synthetic organic chemical that has found many uses in industry and agriculture.

In agriculture, HCB has been used as a fungicide to treat seed grains such as wheat, barley, oats and rye. It has also been found as a contaminant in the herbicide Chlorthal-Dimethyl (dimethyl tetrachloroterephtalate) and in the fungicide Quintozene (pentachloronitrobenzene) in quantities of 5 to 10 % (Courtney, 1979). Both of these pesticides have been used in Atlantic Canada (Environment Canada, 1990a).

Industrially, HCB has been used in the manufacture of electrodes, dyes, and nitroso rubbers for tires. It has also been found as an industrial waste product in the manufacture of perchloroethylene, chlorine, carbon tetrachloride, chlorinated solvents and pesticides. In 1975, it was estimated by the Environmental Protection Agency (EPA) in the United States that 1,950,000 kg per year of HCB had been produced as unwanted by-products (Courtney, 1979).

Hexachlorobenzene therefore found it's way into lakes, rivers and other parts of the environment mainly from industrial discharge, waste disposal and agricultural application. HCB is somewhat volatile and contamination by atmospheric deposition has also been reported (Courtney, 1979). In the Maritime Provinces, HCB has been found in the discharge of chlor-alkali and wood preserving plants (Travers, 1978).

Hexachlorobenzene exhibits very low solubility in water and is very resistant to degradation. It has a strong tendency to accumulate in fatty tissues, and animals at higher levels of the food chain can display a very high biomagnification factor (Courtney, 1979).

In quantitative terms, some physical and chemical properties of HCB are: molecular weight, 284.80; melting point, 227°C/229°C; boiling point 326°C/322°C; vapour pressure, 1.089 X 10^{-5} mm Hg at 20°C; and solubility in water, 0.006 mg/L (Verschueren, 1983). Bioaccumulation factors of 50,000 in bacteria, 1160-3740 in fish, and 290,000 in the lipid content of guppies have been reported (Verschueren, 1983). The half life of HCB in soil has been estimated at 4.2 years (Beck et al., 1974).

The concentration at which HCB becomes toxic is highly dependent on the species affected. In mammals, HCB is moderately toxic and acute signs of toxicity occurred at daily intakes of the order of milligrams per kg of body weight. Death can occur when daily intake reaches the gram per kilogram level (Courtney, 1979). HCB is also a suspected carcinogen but no consensus seem to exist on the effects of long term exposure to low concentrations of the chemical.

The Canadian guidelines for HCB in various water types can be found in table 1.

2. Results and discussion

2.1 Hexachlorobenzene data

A search of the WQB-AR database revealed 1687 HCB samples. Of these, 160 were QC samples, leaving 1527 valid HCB samples. The samples were collected from numerous locations throughout the Atlantic Provinces from 1979 to 1989. Table 2 shows the distribution of HCB samples by provinces and sample types.

In New Brunswick, 315 samples were collected and analyzed for HCB. Of these, 32% came from ground water wells, 25% from lakes and 14% from streams. The rest originated from coastal or estuary waters, biota and sediments. Nearly 72% of the fresh water samples were collected and analyzed as part of an extensive survey of toxic chemicals in municipal drinking water sources (Environment Canada, 1990b). In that study, conducted between 1985 and 1989, the water sources of 37 New Brunswick municipalities were tested for over 150 chemicals. The remaining water samples came from various locations, like Glasier Lake, Madawaska River, Nictau Lake, Saint John River, Mactaquac Lake, Saint John Harbour, Restigouche River, Bathurst Harbour, Miramichi River and Bouctouche Harbour.

Table 1: Guidelines for hexachlorobenzene in water (CCREM, 1987).

water type	guideline
drinking water	no guideline
drinking water sources	no guideline
water for aquatic life	0.0065 ug/L

Table 2: Distribution of valid hexachlorobenzene samples by provinces and sample types.

Type (description)	NB	NS	PEI	NF	TOTAL
00 (stream)	43	83	9	204	339
01 (lake)	79	94	-	127	300
02 (estuary)	21	18	9	3	51
03 (sea)	12	20	15	20	67
05 (impounded reservoir)	-	16	-	8	24
10 (ground water, well)	100	28	160	-	288
33 (precipitation mixed)	-	196	65	-	261
50 (sediment, stream)	-	7	-	8	15
51 (sediment, lake)	12	7	10	15	44
52 (sediment, estuary)	16	10	-	7	33
53 (sediment, harbour)	12	15	7	26	60
90 (biota)	20	18	7	-	45
TOTAL	315	512	282	418	1527

In Nova Scotia, 512 samples were collected and analyzed for HCB. Of these, 38% were from precipitation, 16% from streams and 18% from lakes and impounded reservoirs. The remaining samples consisted of estuary and coastal waters, ground water, biota and sediments. Approximately 60% of the freshwater samples were collected and analyzed as part of an extensive survey of toxic chemicals in municipal drinking water sources (Environment Canada, 1990b). In that study, conducted between 1985 and 1989, the water sources of 38 Nova Scotia municipalities were tested for over 150 chemicals. The precipitation samples were collected as part of a special study on organic contaminants in precipitation and originated from Cobequid and Kejimkujik. Other samples came from various locations, like the Annapolis River and it's estuary, Shubenacadie River, Shubenacadie Lake, Pictou Harbour, Liverpool Bay, LaHave River, Chedabucto Bay and Salmon River.

In Newfoundland and Labrador, 418 samples were collected and analyzed for HCB. Of these, 49% were from streams, 32% from lakes and impounded reservoirs, 6% from coastal waters and estuaries, and 13% from sediments. Almost 47% of the freshwater samples were collected and analyzed as part of an extensive survey of toxic chemicals in municipal drinking water sources (Environment Canada, 1990b). In that study, conducted between 1985 and 1989, the water sources of 40 Newfoundland municipalities were tested for over 150 chemicals. Other samples came from various locations, like Torrent River, Humber River, Indian Brook, Red Indian Lake, Exploits River, Port-aux-Basques Harbour and Saint John's Harbour.

On Prince Edward Island, 282 samples were collected and analyzed for HCB. Of these, 57% originated from ground water and 23% from precipitation. The few remaining samples came from streams, coastal waters, estuaries, biota and sediments. Nearly 95% of the freshwater samples were collected and analyzed as part of an extensive survey of toxic chemicals in municipal drinking water sources (Environment Canada, 1990b). In that study, conducted between 1985 and 1989, the water sources of 8 PEI municipalities were tested for over 150 chemicals. The precipitation samples were collected as part of a special study on organic contaminants in precipitation and originated from Ellerslie. Other samples came from various locations, like the Mill River, Dunk River, Malpeque Bay, Summerside Harbour and Charlottetown Harbour.

The results of all HCB analysis can be found in appendices B and C.

In order to facilitate the viewing of such an amount of information, the data have been graphically represented in figures 3 to 13.

Figure 1 shows the location of sub-basins, while figure 2 shows a description of the graphs. Note that the Y scale, representing concentration, is a log scale and that the size of each point in the graph represents the number of samples that showed a given concentration. "Less than" (L) values were plotted as 100 times less than the specified value and appear in the lower portion of the graphs, usually below the detection limit lines.

2.1.1 Streams

Hexachlorobenzene concentrations in streams are represented in figure 3. As can be seen, only two samples showed detectable HCB concentrations. All other samples were below the detection limits. Those two samples, analyzed in 1980, showed concentrations well below the guideline value of 0.0065 ug/L. They were quantitated at 0.0005 and 0.0006 ug/L, actually below the stated detection limit of 0.002 ug/L for that period, thus decreasing confidence in the results. Subsequent sampling done at the same site (Annapolis River) in 1981 showed no detectable HCB, indicating those values may have been false positives.

2.1.2 Lakes

Hexachlorobenzene concentrations in lakes are represented in figure 4. No HCB was detected in any of the lake samples at a concentration above the detection limit of 0.002 ug/L.

2.1.3 Estuaries

Hexachlorobenzene concentrations in estuaries are represented in figure 5. No HCB was detected in any of the estuary samples at a concentration above the detection limit of 0.002 ug/L.

2.1.4 Coastal Waters

Hexachlorobenzene concentrations in coastal waters are represented in figure 6. Only four samples showed positive HCB concentrations, three of them actually below the stated detection limit. All other samples were below the detection limit of 0.002 ug/L. The positive samples came from two sets of triplicates. One set, taken from Charlottetown Harbour in 1980, showed only one positive value of 0.0005 ug/L while the two other replicates were below the detection limit of 0.002 ug/L, thus casting doubts on the first value. The other set, taken from Liverpool Bay in 1980, near a pulp mill, showed all three replicates to have HCB concentrations ranging from 0.0007 to 0.0022 ug/L, thus suggesting a possible contribution from industrial discharge. In all cases, detected concentrations were below the guideline value of 0.0065 ug/L.

2.1.5 Impounded reservoirs

Hexachlorobenzene concentrations in impounded reservoirs are represented in figure 7. No HCB was detected in any of the impounded reservoir samples at a concentration above the detection limit of 0.002 ug/L.

2.1.6 Ground water

Hexachlorobenzene concentrations in ground water are represented in figure 8. No HCB was detected in any of the ground water samples at a concentration above the detection limit of 0.002 ug/L.

2.1.7 Precipitation

Hexachlorobenzene concentrations in precipitation are represented in figure 9. No HCB was detected in any of the precipitation samples at a concentration above the detection limit of 0.002 ug/L.

2.1.8 Sediments

Hexachlorobenzene concentrations in various type of sediments can be found in figures 10 to 12.

No HCB was detected in any of the stream sediment samples at a concentration above the detection limits of 0.004 and 0.0002 mg/kg. But three 1982 lake sediment samples showed detectable HCB concentrations (fig. 10). Two samples were actually duplicates from Scales Pond (Dunk River, PEI) and both showed a concentration of 0.001 mg/kg. The third sample, coming from Deer Lake (Nfld.), showed a concentration of 0.003 mg/kg and was part of a triplicate set. Oddly, the two other replicates showed no detectable HCB above the detection limit of 0.0002 mg/kg, thus casting doubts on the first value.

In the case of estuary sediments (fig. 11), six samples collected in 1981 showed positive HCB concentrations. The samples came from two sets of triplicates taken from the Annapolis River estuary. One set taken near Mochelle showed concentrations of 0.0004 mg/kg, very near the detection limit of 0.0002 mg/kg. Previous and subsequent sampling done at the same site in 1980 and 1982 showed no detectable HCB concentrations above the detection limit of 0.0002 mg/kg. The other triplicate set, taken at the Highway 201 bridge, showed concentrations of 0.0010 mg/kg and no subsequent sampling was done to confirm those values.

In the case of harbour sediments (fig. 12), only three samples (triplicates) showed positive HCB concentrations, ranging from 0.006 to 0.010 mg/kg. The samples were taken in 1980 from the Restigouche River where it meets Escuminac Bay. No subsequent sampling was done at that site to confirm these values.

There are no guidelines for HCB in sediments.

2.1.9 Biota

In 1979, the Environmental Protection Service (EPS) of Environment Canada conducted a special study on chlorinated benzenes in gull and cormorant eggs (Matheson et al., 1980). Forty-five eggs were collected from colonies at Boot Island (NS), Manawagonish Island (NB) and Cherry Island (PEI). The results of this study were only recently entered in the WQB-AR database and the HCB data are presented in figure 13.

All 45 egg samples showed HCB concentrations ranging from 0.0007 to 0.062 mg/kg. In summary, it was reported that concentrations of HCB in the eggs were considerably higher than that of other chlorobenzenes measured, but that the samples showed considerably less HCB than similar samples from Lake Ontario. The presence of HCB in the eggs was attributed to industrial discharge and past pesticide usage of HCB in Atlantic Canada. After taking into account the results of two previous studies on effluents and sediments, the authors of the EPS report concluded that chlorobenzenes did not represent a serious environmental problem in the Atlantic Region.

2.2 Trends

No trends were evident in this study, as the great majority of HCB values were below the detection limits. But it is interesting to note that all positive HCB values in water samples were generated in 1980, when HCB analysis started. The results for that year should thus be used with caution, since HCB was not found in any water samples after 1980.

2.3 Quality Control

As stated earlier in this report, 160 samples, referred to as QC samples, were removed from the master HCB table and placed in a separate table (appendix C). These actually consisted of valid quality control samples (blanks and spikes) and of unidentified samples which could not be confirmed as valid QC samples (e.g. 00ON00000000).

2.3.1 Blanks

A total of 28 valid HCB water blanks were found in the database, covering the period 1986 to 1989. As it should, all samples marked as blanks showed HCB concentrations less than the stated detection limits of 0.0004 and 0.002 ug/L. No valid blank samples were found for biota or sediment samples.

HCB was not present in the spiking solution used in 1985. It is why all 1985 samples marked as spikes showed "less than" values and can be deemed "pseudo-blanks". Also, four samples

(002302, 601819, 601820, 702554), marked as spikes, showed no detectable HCB concentrations. Close examination of the data confirmed their identity as spikes but suggested that these samples had simply not been spiked for CB's; in all likelihood an error done in the course of conducting field work.

2.3.2 Spikes

The great majority of spikes in the database consisted of water spikes. A few sediment samples were found that had been analyzed as part of an interlab QC study conducted in 1983, but the results of that study could not be obtained and were apparently never published. No biota spikes were found.

Water spikes were of two types: 1) natural water, and 2) distilled or Millipore™ water, to which was added a solution containing chlorobenzenes.

A total of 106 valid HCB water spikes were found, covering the periods 1980-81 and 1986-89. No spikes were found for the period 1982-85. Unfortunately, the percentage recoveries of HCB could only be obtained for 1986-89 spikes from the original (hardcopy) records. The quality control (QC) data for 1980-81 could not be evaluated because the percentage recoveries of spikes were - and still are - not entered in the database and the original records could not be found.

Except for six water spikes analyzed in 1989 under project 216, all valid HCB water spikes were submitted in support of the 1038 water samples analyzed under project 211, the drinking water survey project. The six exceptions just mentioned (sample numbers 905595-7 and 905601-3, appendix C) were submitted to the National Water Quality Laboratory in Burlington (Ontario) for analysis along with 10 water and 10 sediment samples from Newfoundland. These spikes were not included in the statistical calculations presented in table 3 because they represented only 10 water samples and because they would have affected the 1989 recovery data and distorted the yearly comparisons since all the other water spikes were analyzed by the WQB-AR laboratory. Statistics for those six water spikes are: mean 64.7%, median 60.0%, standard deviation 20.9%, maximum 93.0%, and minimum 40.0%. All ten water samples supported by those spikes were reported as less than 0.0004 ug/L.

The recoveries of HCB from water spikes are summarized in table 3. As can be seen, those water QC data were multi-dimensional in nature, the samples being of different water types, collected in different provinces and in different years.

The overall mean recovery of HCB from 1986-89 water spikes was considered very good at 90% with a standard deviation of 21.3. Yearly data revealed that recoveries of HCB improved over the years as shown by the higher mean recoveries and lower standard deviations, especially between 1986 and later years. Province wise, the between province mean recoveries of HCB spikes were all above 80%. Recoveries of HCB from distilled water spikes and natural water

Table 3: Percent recovery of hexachlorobenzene from water samples analyzed by the WQB-AR: overall, by year, by province and by water type.

	N	mean	median	stdev	max	min
overall	68	90.0	95.0	21.3	143	38
1986	16	78.5	75.0	22.4	112	38
1987	23	91.4	88.0	24.6	143	50
1988	23	96.4	101.0	16.8	116	56
1989	6	91.0	89.2	8.3	104	83
NB	17	95.7	102.0	16.9	112	53
NFLD	17	81.0	85.0	24.1	120	50
NS	16	95.9	98.5	24.9	143	38
PEI	18	87.9	86.5	16.6	112	56
dist. water	22	92.0	94.3	18.4	133	55
surface water	26	86.3	91.5	25.5	143	38
ground water	22	91.0	97.2	18.9	112	53

Note: HCB was not present in the spiking solution used in 1985. Also, the percentage recoveries could not be found for water spikes analyzed in 1980 and 1981. No water QC samples were found for the years 1982-84.

spikes were both excellent, being within 86 to 92%. It was interesting to note that the mean recoveries of HCB from distilled water and ground water spikes were similar, while the mean recovery from surface water spikes was slightly lower with a higher standard deviation. Surface waters usually contain greater amounts of microorganisms, organic matter and suspended matter than ground water, and it is believed that uptake of HCB by microorganisms and adsorption onto the organic and suspended matter in the spikes could have reduced the amounts of HCB recoverable from the samples. Nevertheless, except for an occasional low or high recovery, no problems were noted for HCB analysis in water samples.

Even though the water samples analyzed in 1985 were only supported by the pseudo-blanks mentioned previously, it is nonetheless the author's opinion that HCB results reported for water samples between 1985 and 1989 were reliable. However, no QC data could be validated to support pre-1985 water, biota or sediments results, thus decreasing the confidence in those results.

3. Conclusion

This report was initiated in support of the new Canadian Environmental Protection Act (CEPA). It summarized 10 years of hexachlorobenzene data mostly generated by the Water Quality Branch in the Atlantic Region.

Hexachlorobenzene analysis was performed on over 1500 samples encompassing streams, lakes, estuaries, ground water, precipitation, biota and sediments. The great majority of samples (99%) was reported as having HCB concentrations less than the applicable detection limits; 0.002 ug/L for most water samples, and 0.0002, 0.002 or 0.004 mg/kg for biota and sediment samples.

Only six water samples, analyzed in 1980, showed positive HCB concentrations ranging from 0.0005 to 0.0022 ug/L. They were taken from three sites: Charlottetown Harbour (PEI), Annapolis River (NS) and Liverpool Bay (NS). All were below 0.0065 ug/L, the guideline value for aquatic life. No HCB was found in any water samples after 1980.

Only 12 sediment samples analyzed in 1980-82 (seven of them replicates), showed positive HCB concentrations ranging from 0.0004 to 0.010 mg/kg. They were taken from four sites: Annapolis River (NS), Restigouche River (NB), Scales Pond (PEI) and Deer Lake (Nfld.). There are presently no guidelines for HCB in sediments, but the low number of samples showing positive HCB concentrations and the concentrations encountered suggest a low level of contamination.

All 45 gull and cormorant egg samples collected and analyzed in 1979 by the Environmental Protection Service of Environment Canada showed HCB concentrations ranging from 0.0007 to 0.062 mg/kg. This clearly showed that HCB can bioaccumulate and move up the food chain.

Valid HCB spikes and blanks were found to support water samples data produced between 1985 and 1989, but because of the lack of suitable quality control data prior to 1985, all the results generated between 1980 and 1984 should be used with caution. In light of the difficulty in retrieving the percent recoveries of spikes from original records (hardcopies), mechanisms need to be implemented so that the percent recoveries of spikes are entered in the database along with the empirical values.

It was not surprising to find that HCB concentrations in water were very low and in most cases not detected. HCB is very hydrophobic and rather tends to concentrate on suspended matter and in sediments, where it becomes available for bioaccumulation. Only in an area seriously contaminated with HCB could one expect to find significant quantities of HCB in water, although water samples coming from slightly contaminated areas but containing much suspended matter could also show positive HCB concentrations. In assessing HCB contamination in the aquatic environment, it would therefore be more worthwhile to focus the analytical efforts on sediment and biota samples rather than on water samples, and to develop adequate quality control protocols to support those results.

Based on the data presented in this report, it was concluded that the presence of hexachlorobenzene in Atlantic Canada's environment seems to be limited and mostly localized to sites where some industrial activities occur, and that hexachlorobenzene is not, at the moment, a problem compound in Atlantic Canada's environment.

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5. Acknowledgements

Many thanks to Cathy Cormier for programming the special plotting routine, and to Tom Pollock and Hugh O'Neill for reviewing this document.

FIG. 1: SUB-BASINS AND THEIR LOCATION

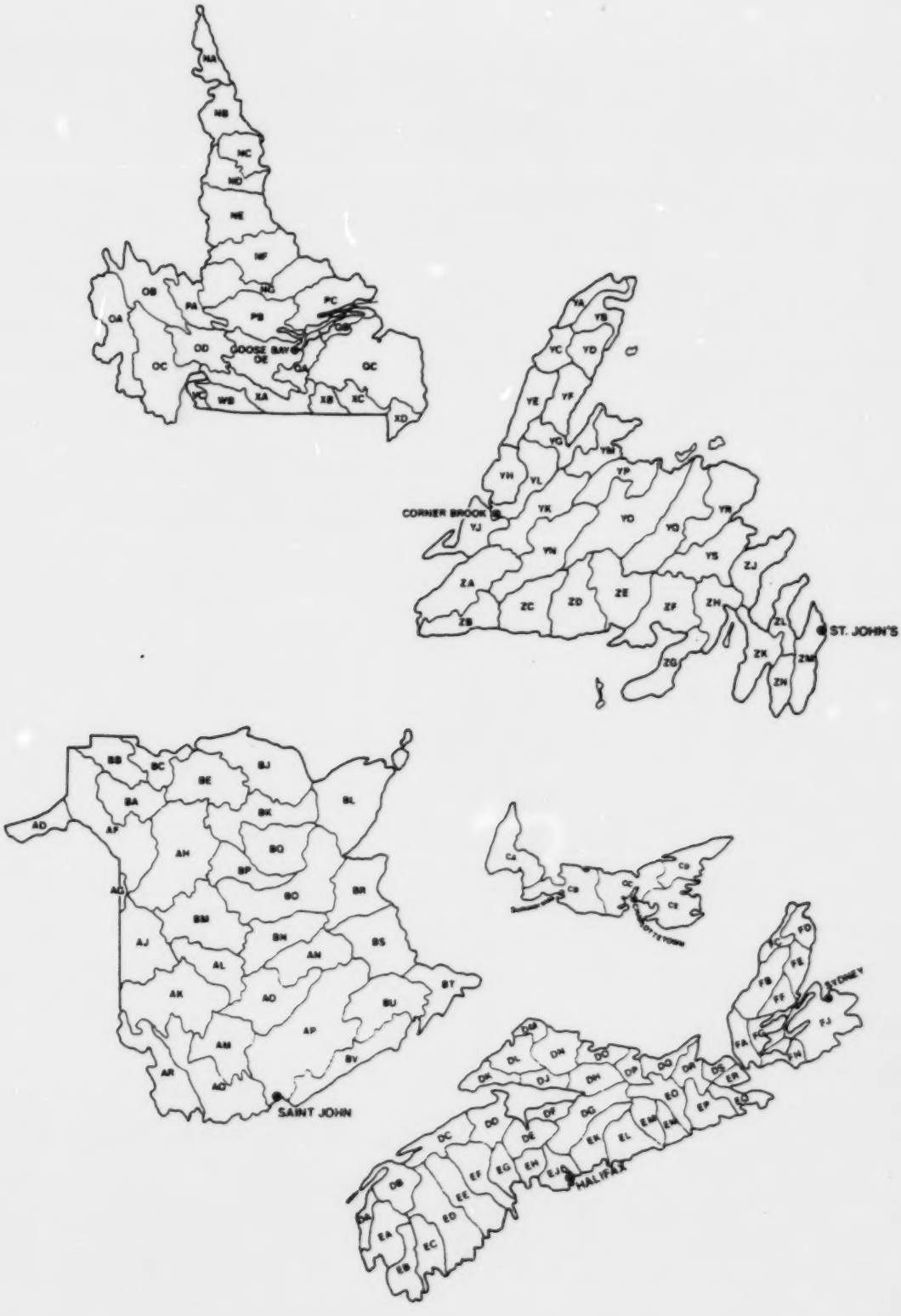
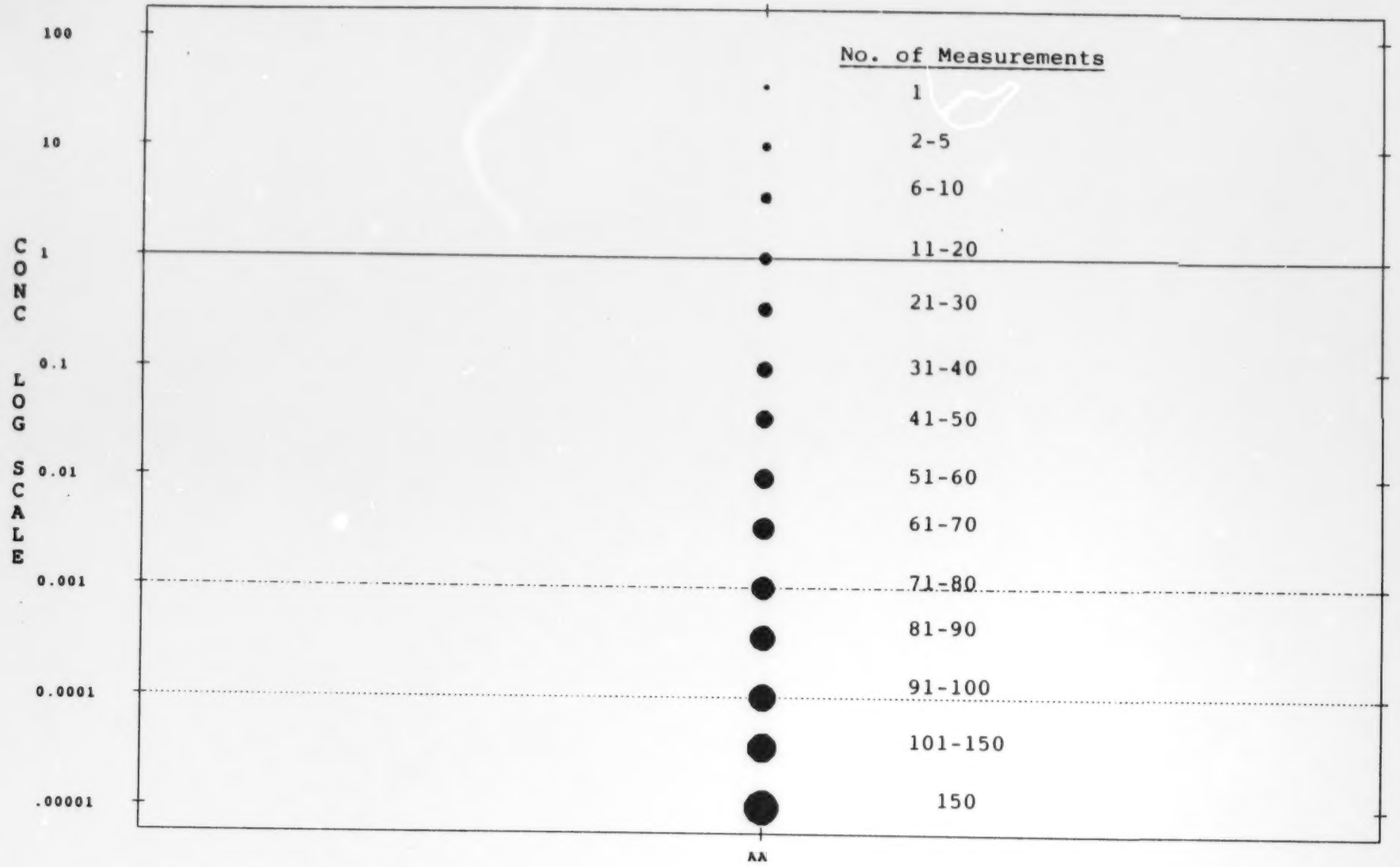


FIG. 2: DESCRIPTION OF GRAPHS (SAMPLING PERIOD)



SUB-BASINS (SEE FIG. 1)

——— APPLICABLE GUIDELINE
- - - - - DETECTION LIMIT A ("LESS THAN" VALUES PLOTTED AS)
..... DETECTION LIMIT B (100X LESS THAN STATED VALUE)

FIG. 3: HEXACHLOROBENZENE IN ATLANTIC CANADA STREAMS (1980-1989)

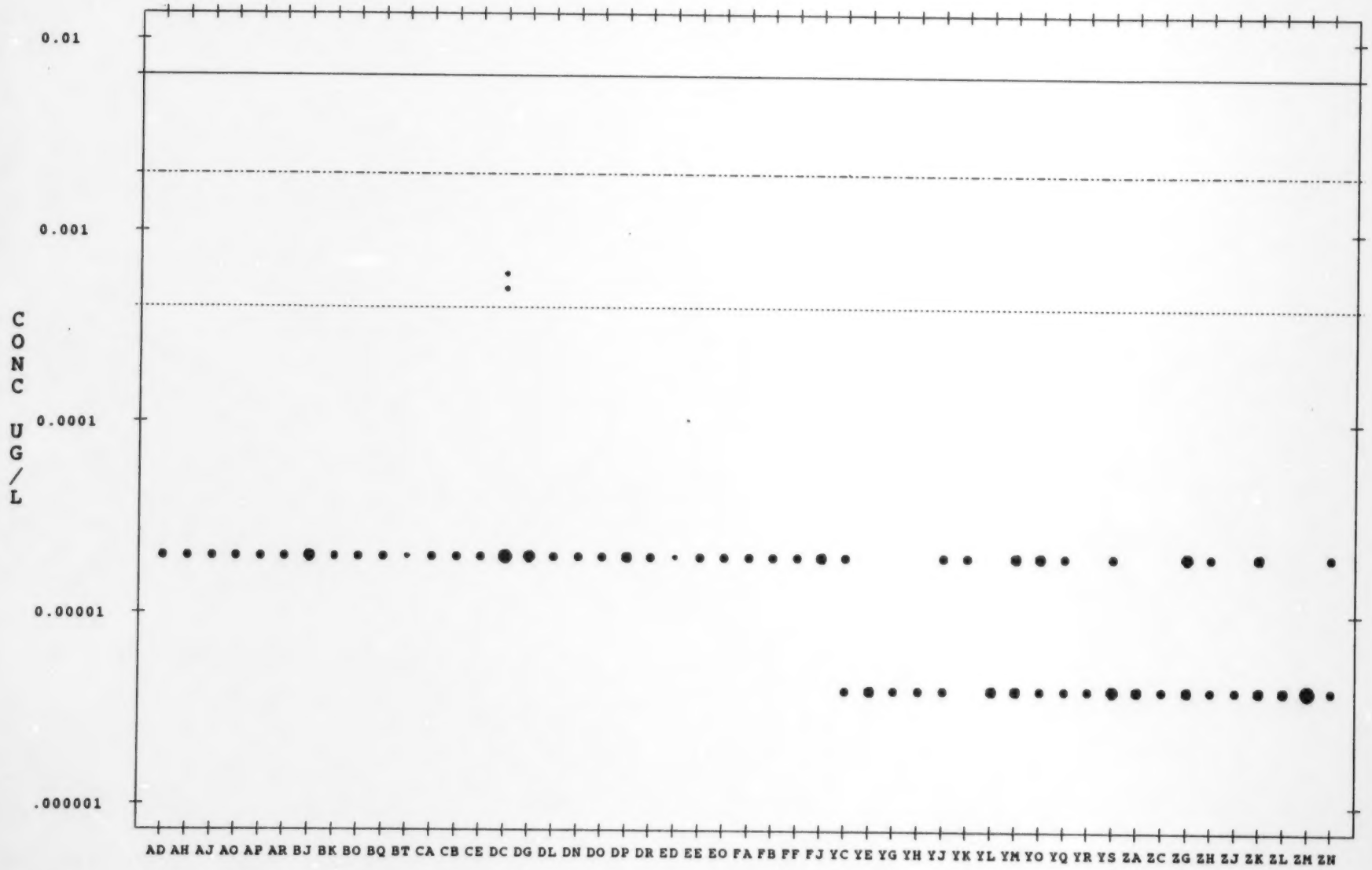

0.01
0.001
0.0001
0.00001
.000001
CONC UG/L
AD AH AJ AO AP AR BJ BK BO BQ BT CA CB CE DC DG DL DN DO DP DR ED EE EO FA FB FF FJ YC YE YG YH YJ YK YL YM YO YQ YR YS ZA ZC ZG ZH ZJ ZK ZL ZM ZN
SUB-BASINS
CCREM GUIDELINE 0.0065 UG/L
DETECTION LIMIT 0.002 UG/L
DETECTION LIMIT 0.0004 UG/L

FIG. 4: HEXACHLOROBENZENE IN ATLANTIC CANADA LAKES (1980-1989)

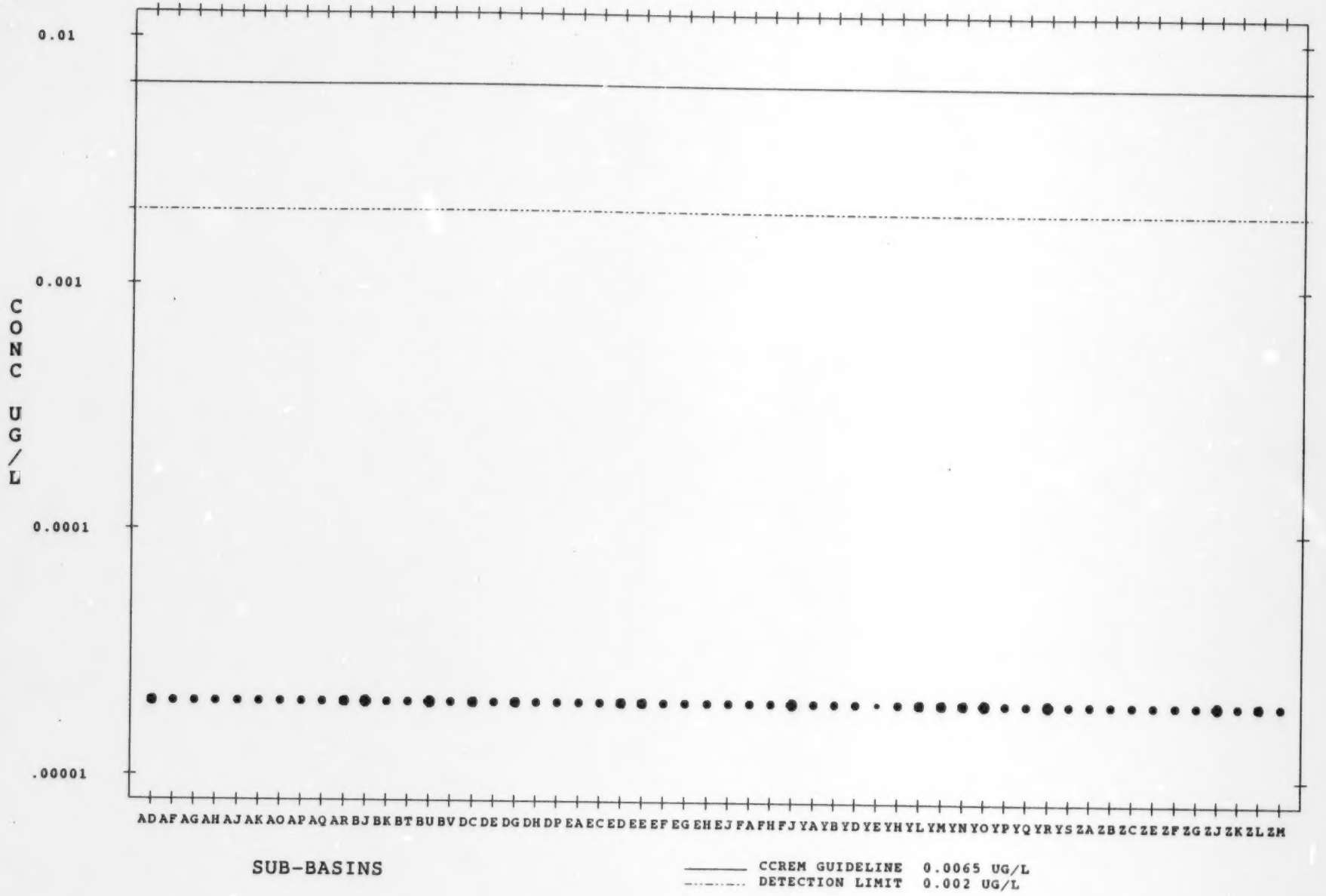

0.01
0.001
0.0001
.00001
CONC UG/L
AD AF AG AH AJ AK AO AP AQ AR BJ BK BT BU BV DC DE DG DH DP EA EC ED EE EF EG EH EJ FA FH FJ YA YB YD YE YH YL YM YN YO YP YQ YR YS ZA ZB ZC ZE ZF ZG ZJ ZK ZL ZM
SUB-BASINS
CCREM GUIDELINE 0.0065 UG/L
DETECTION LIMIT 0.002 UG/L

FIG. 5: HEXACHLOROBENZENE IN ATLANTIC CANADA ESTUARIES (1980-1982)

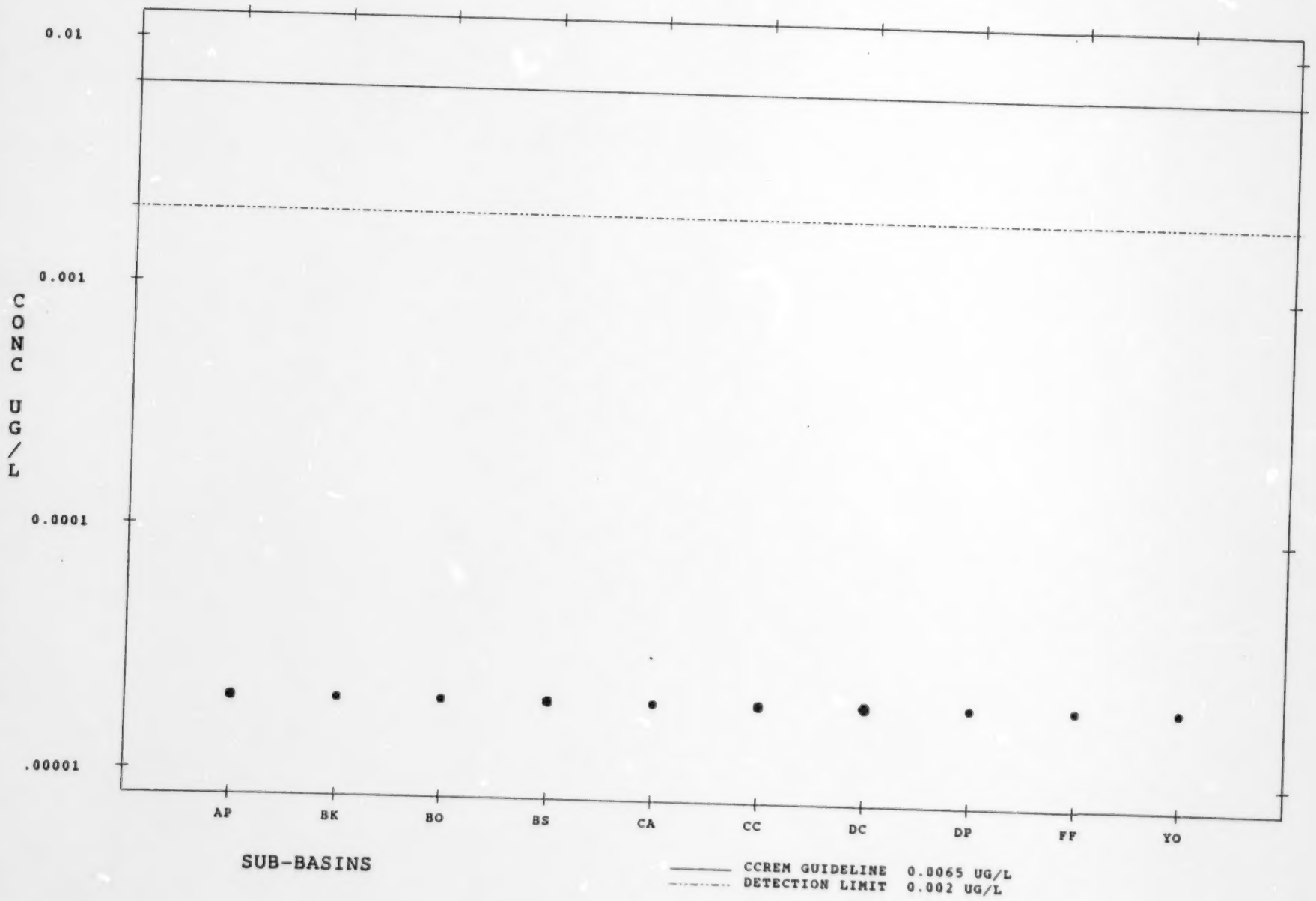


FIG. 6: HEXACHLOROBENZENE IN ATLANTIC COASTAL WATERS (1980-1982)

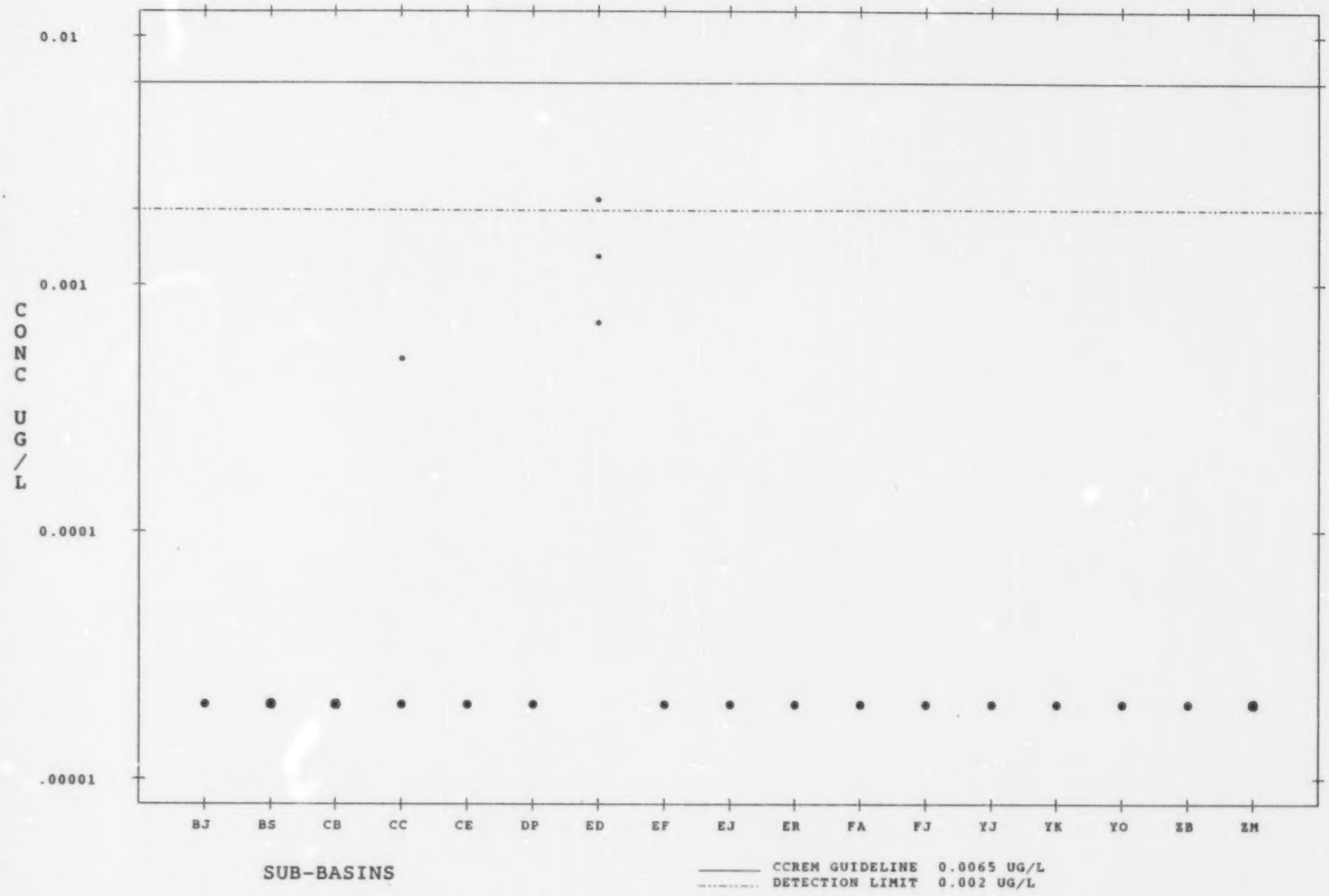


FIG. 7: HEXACHLOROBENZENE IN NS AND NFLD IMPOUNDED RESERVOIRS (1987-1988)

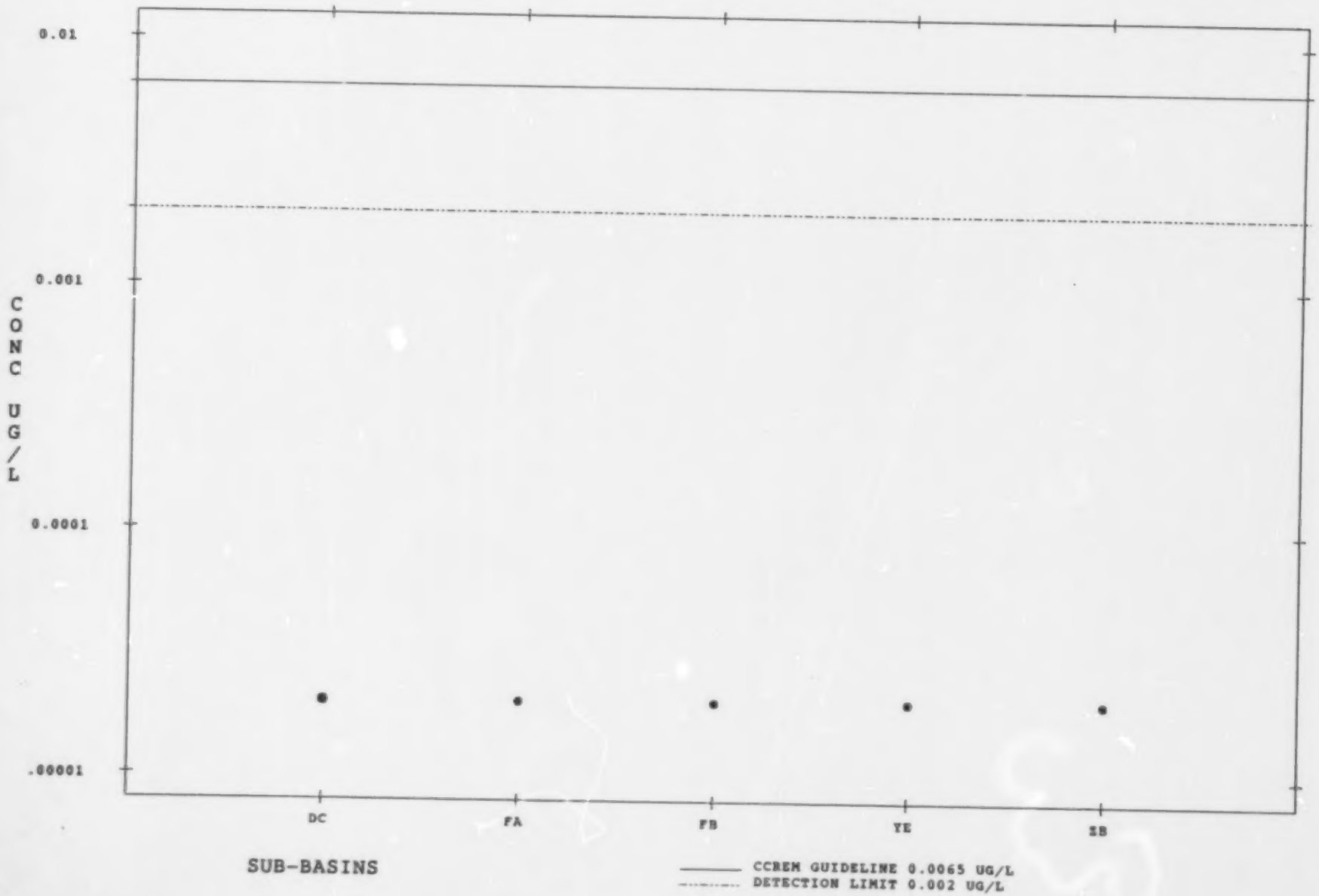


FIG. 8: HEXACHLOROBENZENE IN NB, PEI AND NS GROUNDWATER (1986-1989)

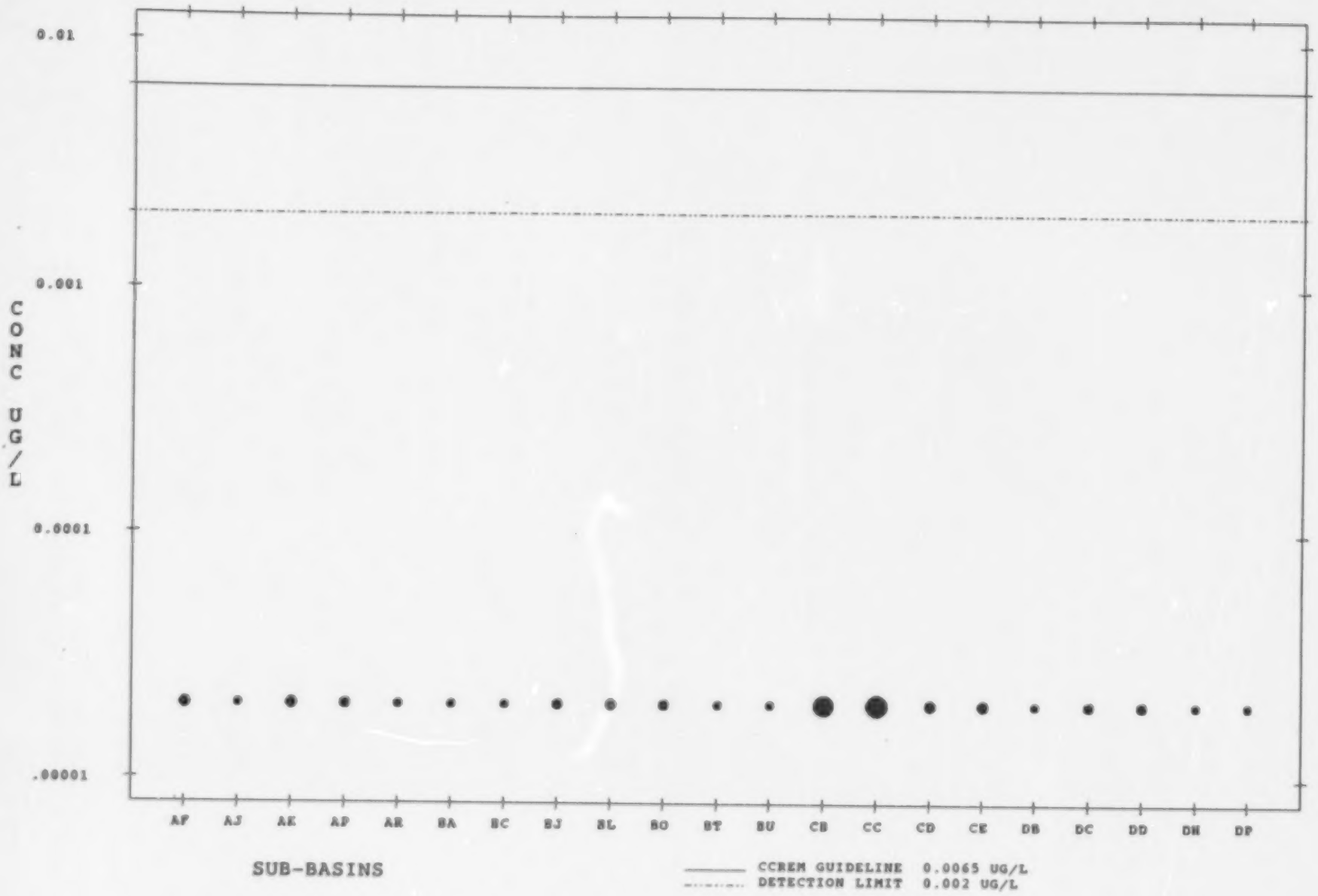


FIG. 9: HEXACHLOROBENZENE IN PEI AND NS PRECIPITATION (1980-1989)

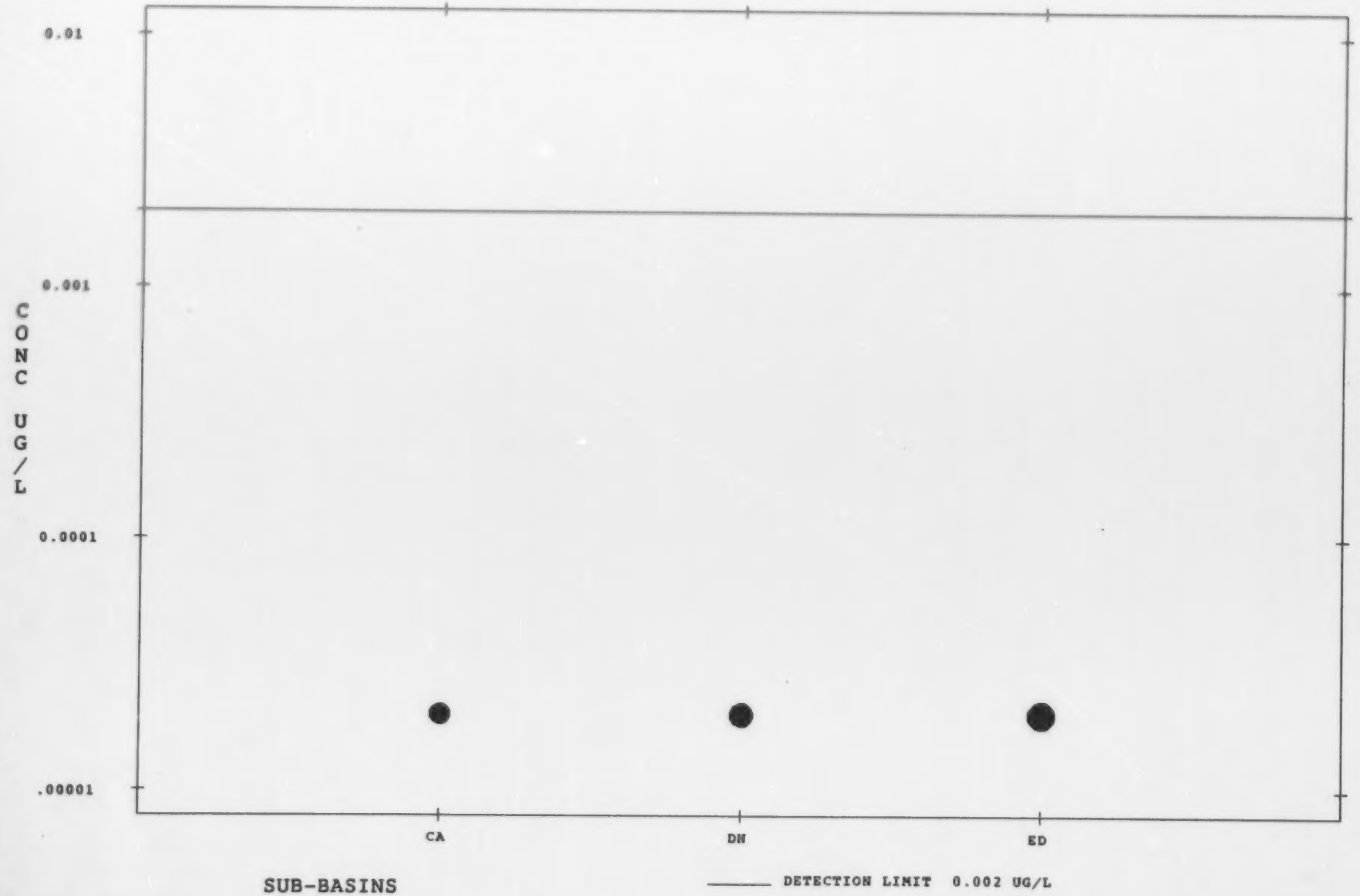


FIG. 10 HEXACHLOROBENZENE IN ATLANTIC CANADA LAKE AND STREAM SEDIMENTS (1980-83, 1987)

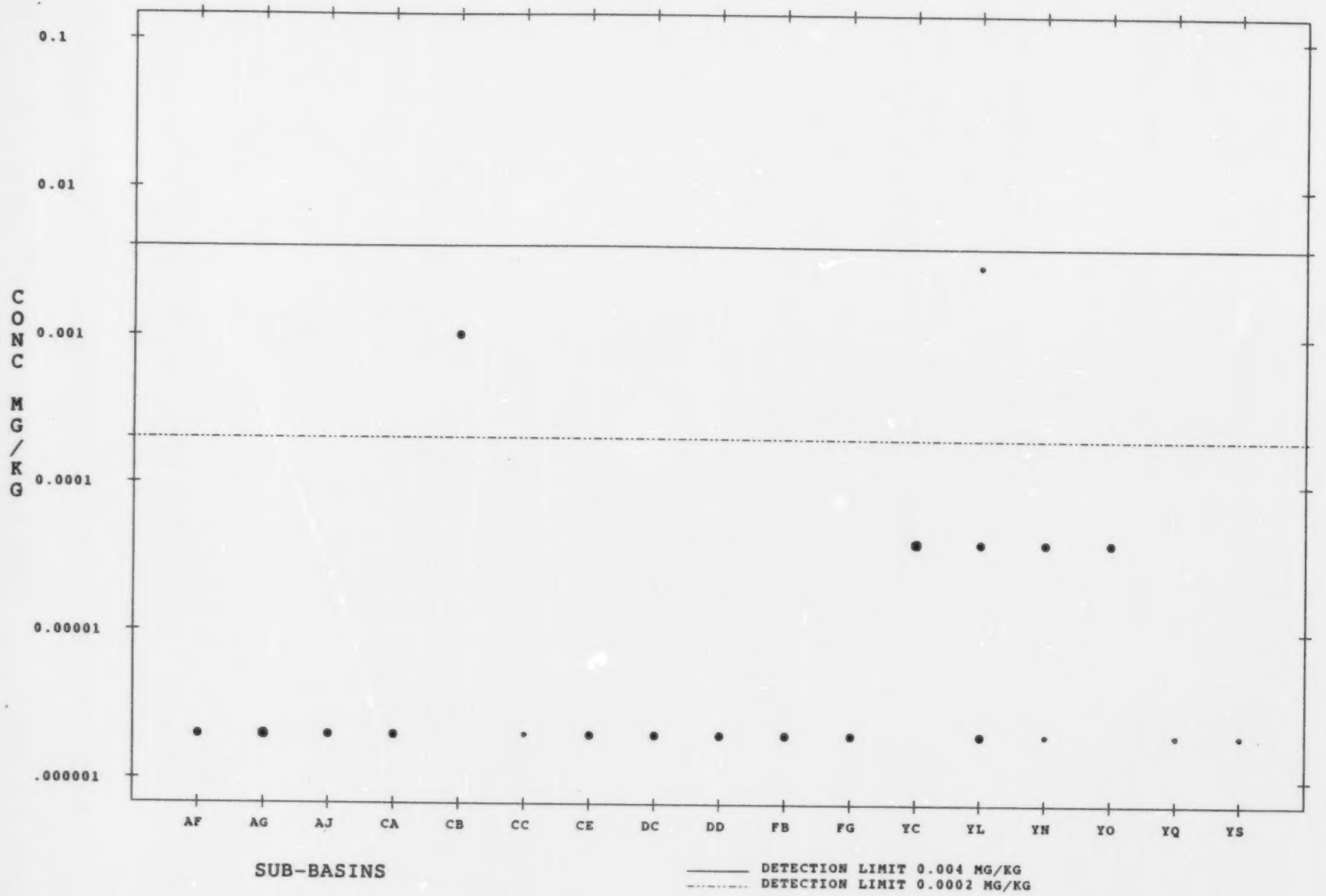


FIG. 11: HEXACHLOROBENZENE IN NB, NS AND NFLD ESTUARY SEDIMENTS (1980-82, 1987)

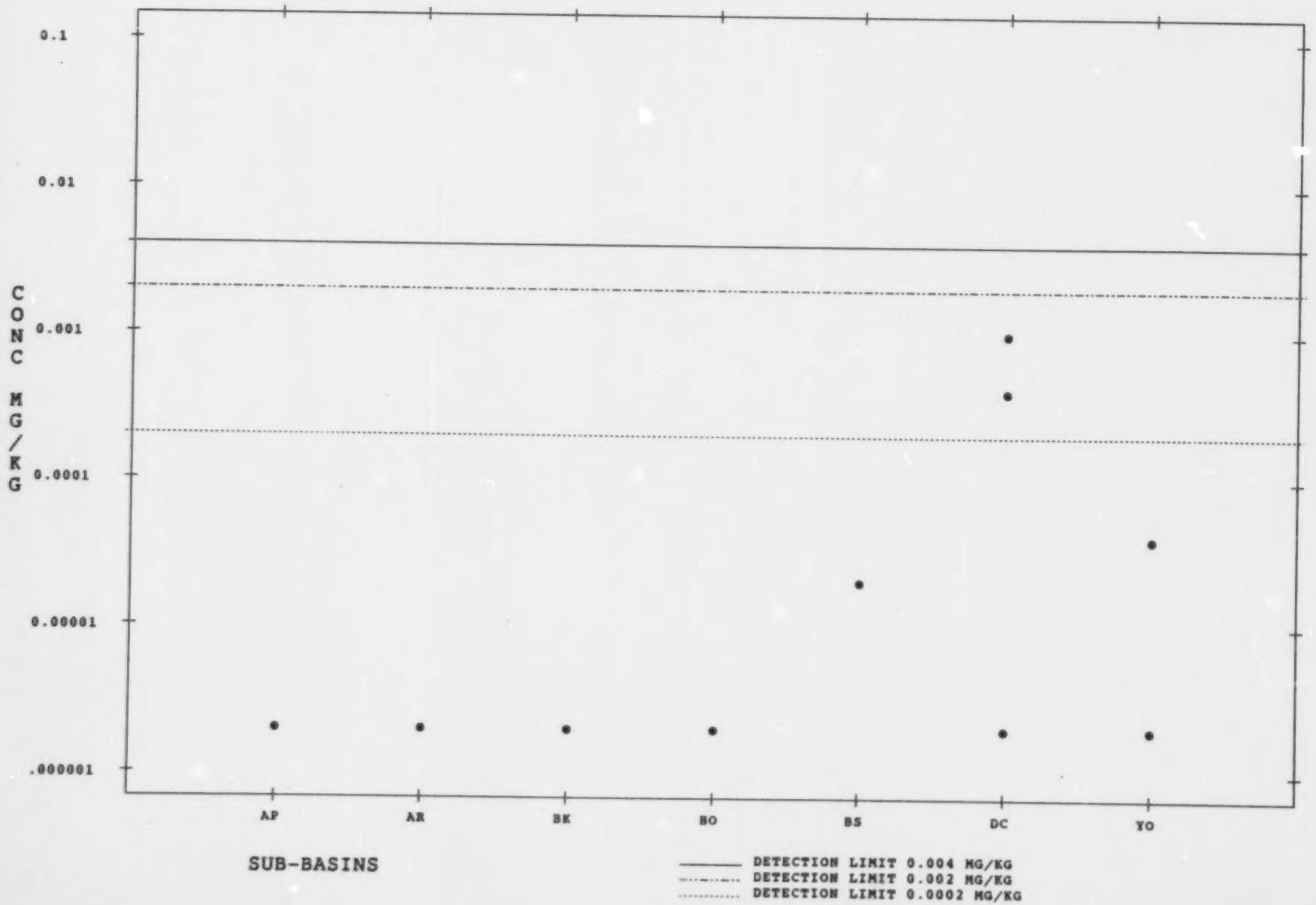


FIG. 12: HEXACHLOROBENZENE IN ATLANTIC CANADA HARBOUR SEDIMENTS (1980, 1982, 1987)

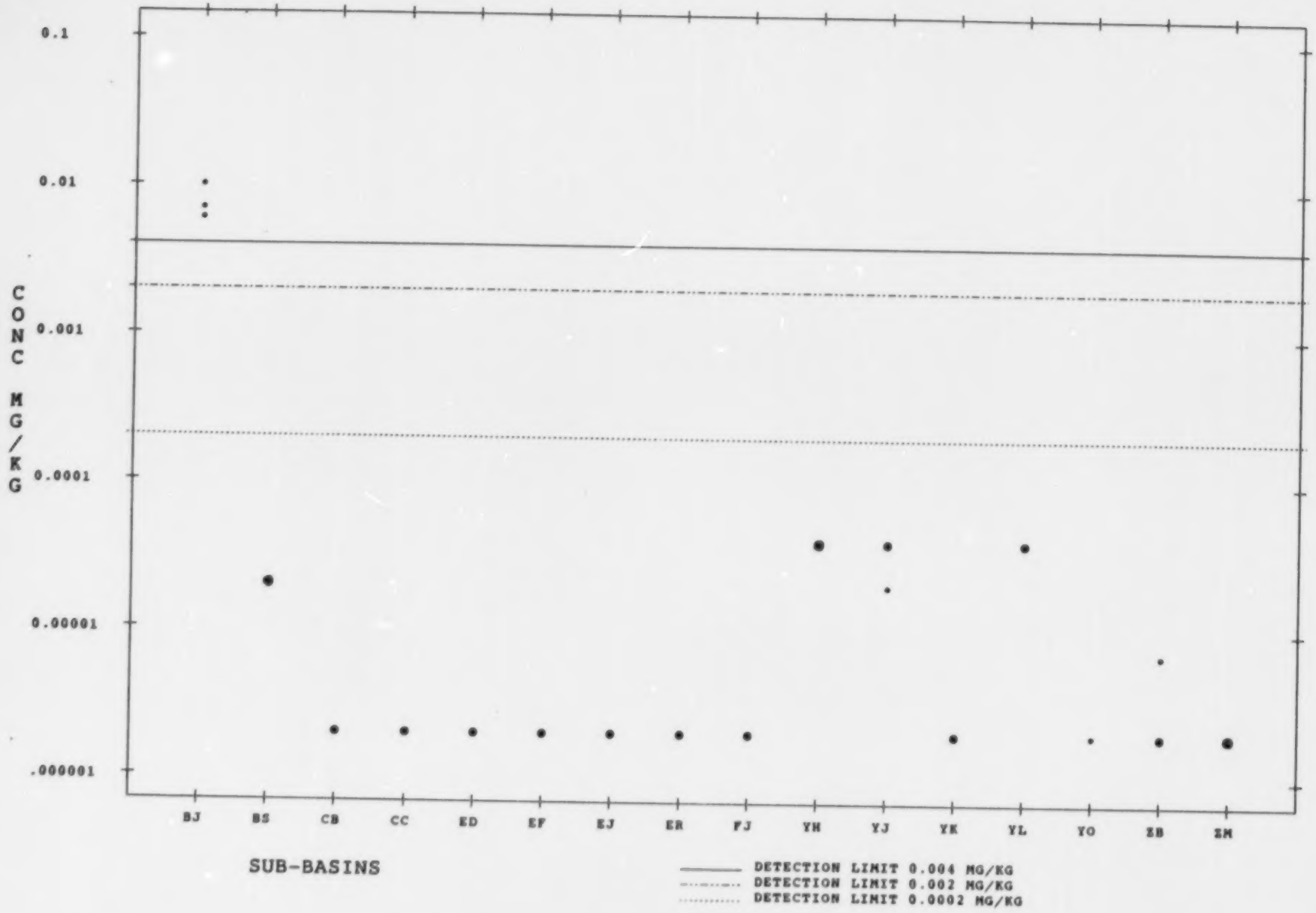
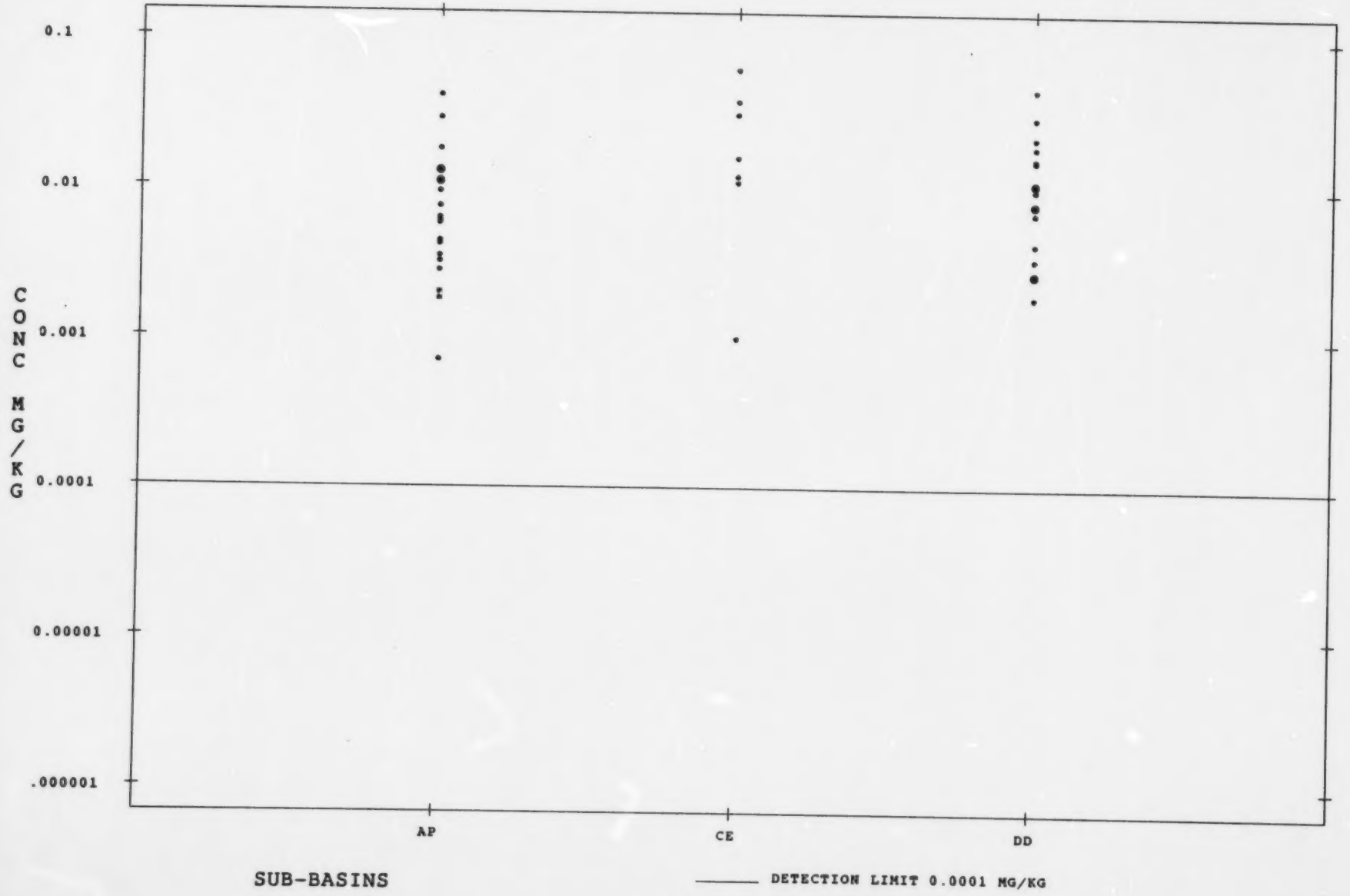


FIG. 13: HEXACHLOROBENZENE IN NB, PEI AND NS BIOTA (1979)



APPENDIX A

The Water Quality Branch - Atlantic Region database

Searching the WQB-AR database

At the time of this writing, the WQB-AR database was divided into three sections: pre-1980 data, 1980-1989 data and post-1989 data. The data were retrieved with the program RS1PERM by specifying a date range and the method codes for HCB (also known as parameter codes). The method codes used are listed in table 4. The database was searched using the date range 01/01/63 to 31/12/89.

The upper range of the search was limited to 1989 data because that portion of the database is fairly static now; very little change should occur in that section of the database. In contrast, 1990 data are at the moment (February 1991) still being produced and entered in the database. The data presented in this report are current as of January 1991.

The hexachlorobenzene data

Table 5 shows the number of values per parameter code resulting from the search. As can be seen, 1687 samples were found. Not all samples were valid; 160 samples were quality control samples or showed invalid station numbers (e.g. 00ON00000000). Table 6 shows the number of samples per parameter code with invalid samples excluded.

Initially, nearly 90 samples showed "00XX00000000" station numbers or were otherwise not properly identified. Upon verification, those samples proved to be real samples, interlaboratory QC study samples, unidentified test samples, one-time grab samples outside existing sampling stations or special project samples. Correct station numbers were found and assigned to 77 of them resulting in the proper identification and the creation of 42 real samples and 35 1980-81 spikes. Previously, no valid QC samples could be identified for those years. Unfortunately, the percentage recoveries of these newly found spikes could not be established because of the lack of information in the database and the age of the records. Also, despite many efforts, the results of interlaboratory QC studies on HCB in water and sediment samples, conducted in 1983, could not be procured from the originating agency. The results were apparently never published.

A certain number of manipulations were necessary to bring the data into a format suitable for plotting and publishing. First, QC and invalid samples were removed and placed in a separate table (appendix C). Then, all values reported under parameter code 17814L were changed to ug/L (from ng/L) in order to make them comparable with those from code 17812L. Finally, all the values were reported to one column labelled "HCB". The table of "valid" HCB samples thus created can be found in appendix B.

For information purposes, the number of valid HCB samples per sub-ID (or project number) is presented in table 7, while the number of valid HCB samples by province and sample type can be found in table 2.

Table 4: Method codes for hexachlorobenzene and their description (NAQUADAT, 1988).

method code[1]	unit	description
17812L	ug/L	water sample extracted with hexane, analysis by capillary column gas chromatography (HRGC) with electron capture detector (ECD)
17814L	ng/L	water sample extracted with dichloromethane, silica gel column cleanup, analysis by HRGC-ECD
17816L	mg/kg	sediment sample extracted with 1:1 acetone/hexane, ultra-sonic extraction, florisil column cleanup, analysis by GC-ECD
17817L	mg/kg	sediment, extraction by steam distillation, partition with hexane, HRGC-ECD

[1] the letter following each method code is the "place of analysis" code, L = laboratory.

NAQUADAT (1988). Dictionary of Parameter Codes. Data Systems Section, Water Quality Branch, Environment Canada, Ottawa.

Table 5: Number of hexachlorobenzene samples per method code for pre- and post-1980 years (7/05/79 - 31/12/89). All samples included.

year	method code 17812L	17814L	17816L	17817L	TOTAL
1979	-	-	45	-	45
1980	145	-	-	54	199
1981	160	-	-	7	167
1982	61	-	-	57	118
1983	32	-	-	5	37
1984	22	-	-	-	22
1985	167	-	-	-	167
1986	221	44	-	-	265
1987	218	47	34	-	299
1988	228	45	-	-	273
1989	77	18	-	-	95
TOTAL	1331	154	79	123	1687

Table 6: Number of hexachlorobenzene samples per method code for pre- and post-1980 years (7/05/79 - 31/12/89). Invalid station numbers and quality control samples excluded.

	method code				
year	17812L	17814L	17816L	17817L	TOTAL
1979	-	-	45	-	45
1980	137	-	-	54	191
1981	135	-	-	6	141
1982	61	-	-	56	117
1983	26	-	-	1	27
1984	22	-	-	-	22
1985	153	-	-	-	153
1986	199	44	-	-	243
1987	186	47	34	-	267
1988	197	45	-	-	242
1989	69	10	-	-	79
TOTAL	1185	146	79	117	1527

Table 7: Number of valid hexachlorobenzene samples per sub-ID.

sub-ID	# samples	description of sub-ID
162	264	Organic contaminants in precipitation
211	1038	Atlantic region toxic substances study
215	160	Federal/Provincial agreements sampling program, Nfld.
216	20	Canada-Newfoundland agreement: recurrent water survey
900	45	Temporary sub-id assigned to EPS data
TOTAL	1527	

APPENDIX B

Valid hexachlorobenzene data sorted by sample type, value and date.

Explanation of table

STN = station number: a 12-digit code containing information about the sample.
Digits 1 and 2 represent the sample type (see table 2).
Digits 3 and 4, the province code.
Digits 5 and 6, the basin code.
Digits 7 and 8, the sub-basin code (see figure 1).
Digits 9 to 12 are a numerical code assigned by the regional office.

SAMPLE = sample number assigned by the laboratory.

SDATE = sampling date.

SUBID = number representing the project for which the sample was collected (see table 7).

HCB = reported concentration of hexachlorobenzene found in sample, either in ug/L or mg/kg depending on the sample type. "L" preceeding a value indicates that HCB concentration in the sample was less than the stated limit of detection.

0	1 STN	2 SAMPLE	3 SDATE	4 SUBID	5 HCB
1	00NS01DC0001	2216	23-SEP-80	211	0.0005
2	00NS01DC0001	2214	23-SEP-80	211	0.0006
3	00NF02ZL0001	705792	04-NOV-86	215	L.0004
4	00NF02ZL0001	705793	04-NOV-86	215	L.0004
5	00NF02ZL0002	705794	04-NOV-86	215	L.0004
6	00NF02ZA0003	705072	05-NOV-86	215	L.0004
7	00NF02ZA0006	705069	05-NOV-86	215	L.0004
8	00NF02ZA0006	705070	05-NOV-86	215	L.0004
9	00NF02ZG0016	705795	05-NOV-86	215	L.0004
10	00NF02ZG0024	705791	05-NOV-86	215	L.0004
11	00NF02ZG0025	705796	05-NOV-86	215	L.0004
12	00NF02YL0012	705073	06-NOV-86	215	L.0004
13	00NF02YG0001	705074	07-NOV-86	215	L.0004
14	00NF02YJ0001	705075	10-NOV-86	215	L.0004
15	00NF02YJ0001	705076	10-NOV-86	215	L.0004
16	00NF02ZH0010	705797	10-NOV-86	215	L.0004
17	00NF02YM0003	705025	12-NOV-86	215	L.0004
18	00NF02YM0004	705024	12-NOV-86	215	L.0004
19	00NF02ZJ0024	705027	13-NOV-86	215	L.0004
20	00NF02ZJ0024	705028	13-NOV-86	215	L.0004
21	00NF02YE0005	705806	17-NOV-86	215	L.0004
22	00NF02YD0021	705798	17-NOV-86	215	L.0004
23	00NF02YD0021	705799	17-NOV-86	215	L.0004
24	00NF02YC0002	705807	18-NOV-86	215	L.0004
25	00NF02YC0002	705808	18-NOV-86	215	L.0004
26	00NF02YE0004	705809	18-NOV-86	215	L.0004
27	00NF02ZM0018	705814	18-NOV-86	215	L.0004
28	00NF02ZM0018	705815	18-NOV-86	215	L.0004
29	00NF02ZM0019	705816	18-NOV-86	215	L.0004
30	00NF02YH0018	705810	19-NOV-86	215	L.0004
31	00NF02YS0005	705801	19-NOV-86	215	L.0004
32	00NF02YS0010	705800	19-NOV-86	215	L.0004
33	00NF02YS0011	705802	20-NOV-86	215	L.0004
34	00NF02YG0005	705803	21-NOV-86	215	L.0004
35	00NF02YL0013	705811	24-NOV-86	215	L.0004
36	00NF02YL0013	705812	24-NOV-86	215	L.0004
37	00NF02YR0001	705804	24-NOV-86	215	L.0004
38	00NF02YR0001	705805	24-NOV-86	215	L.0004
39	00NF02ZC0001	705813	26-NOV-86	215	L.0004
40	00NF02ZK0001	705818	26-NOV-86	215	L.0004
41	00NF02ZK0005	705817	26-NOV-86	215	L.0004
42	00NF02ZM0017	705819	27-NOV-86	215	L.0004
43	00NF02ZM0009	705822	28-NOV-86	215	L.0004
44	00NF02ZM0009	705823	28-NOV-86	215	L.0004
45	00NF02ZM0015	705821	28-NOV-86	215	L.0004
46	00NF02ZM0020	705820	28-NOV-86	215	L.0004
47	00NF02YM0004	705740	02-NOV-87	215	L.0004
48	00NF02YM0004	705741	02-NOV-87	215	L.0004
49	00NF02YM0003	705742	03-NOV-87	215	L.0004
50	00NF02ZG0016	705746	03-NOV-87	215	L.0004
51	00NF02ZG0024	705747	03-NOV-87	215	L.0004
52	00NF02YJ0001	705878	04-NOV-87	215	L.0004
53	00NF02YD0021	705744	04-NOV-87	215	L.0004
54	00NF02ZA0006	705881	04-NOV-87	215	L.0004
55	00NF02ZA0007	705879	04-NOV-87	215	L.0004
56	00NF02ZA0007	705880	04-NOV-87	215	L.0004
57	00NF02ZG0025	705748	04-NOV-87	215	L.0004
58	00NF02ZH0010	705749	04-NOV-87	215	L.0004
59	00NF02ZJ0024	705745	05-NOV-87	215	L.0004
60	00NF02ZL0001	705750	05-NOV-87	215	L.0004
61	00NF02ZL0002	705751	05-NOV-87	215	L.0004
62	00NF02ZL0002	705752	05-NOV-87	215	L.0004
63	00NF02YG0001	705882	09-NOV-87	215	L.0004
64	00NF02YL0012	705883	09-NOV-87	215	L.0004
65	00NF02YL0012	705884	09-NOV-87	215	L.0004
66	00NF02ZM0019	705753	09-NOV-87	215	L.0004
67	00NF02YE0004	705889	16-NOV-87	215	L.0004
68	00NF02YE0005	705887	16-NOV-87	215	L.0004
69	00NF02YE0005	705888	16-NOV-87	215	L.0004
70	00NF02YH0018	705885	16-NOV-87	215	L.0004
71	00NF02YH0018	705886	16-NOV-87	215	L.0004
72	00NF02YB0005	705839	17-NOV-87	215	L.0004
73	00NF02ZC0001	705842	17-NOV-87	215	L.0004
74	00NF02ZC0001	705843	17-NOV-87	215	L.0004
75	00NF02ZM0017	705845	17-NOV-87	215	L.0004
76	00NF02ZM0018	705844	17-NOV-87	215	L.0004
77	00NF02YC0002	705840	19-NOV-87	215	L.0004
78	00NF02YS0011	705830	19-NOV-87	215	L.0004
79	00NF02YS0011	705831	19-NOV-87	215	L.0004
80	00NF02ZM0020	705846	20-NOV-87	215	L.0004
81	00NF02ZM0020	705847	20-NOV-87	215	L.0004
82	00NF02YL0013	705841	23-NOV-87	215	L.0004
83	00NF02YR0001	705832	23-NOV-87	215	L.0004
84	00NF02ZM0009	705849	23-NOV-87	215	L.0004
85	00NF02ZM0015	705848	23-NOV-87	215	L.0004
86	00NF02YS0005	705835	24-NOV-87	215	L.0004
87	00NF02YS0005	705836	24-NOV-87	215	L.0004
88	00NF02YS0010	705833	24-NOV-87	215	L.0004
89	00NF02YS0010	705834	24-NOV-87	215	L.0004
90	00NF02ZK0001	705837	24-NOV-87	215	L.0004
91	00NF02ZK0005	705850	24-NOV-87	215	L.0004
92	00NF02ZK0005	705851	24-NOV-87	215	L.0004
93	00NF02ZN0004	705838	26-NOV-87	215	L.0004
94	00NF02YM0003	805100	02-MAY-88	215	L.0004
95	00NF02YM0003	805101	02-MAY-88	215	L.0004
96	00NF02YM0004	805097	02-MAY-88	215	L.0004
97	00NF02YJ0001	805111	03-MAY-88	215	L.0004
98	00NF02YJ0001	805112	03-MAY-88	215	L.0004
99	00NF02ZA0006	805106	03-MAY-88	215	L.0004
100	00NF02ZA0006	805107	03-MAY-88	215	L.0004
101	00NF02ZA0007	805113	03-MAY-88	215	L.0004
102	00NF02ZL0001	805102	03-MAY-88	215	L.0004
103	00NF02ZL0002	805103	03-MAY-88	215	L.0004
104	00NF02ZJ0024	805098	04-MAY-88	215	L.0004
105	00NF02ZM0017	805105	04-MAY-88	215	L.0004
106	00NF02ZM0018	805104	04-MAY-88	215	L.0004
107	00NF02YG0001	805108	05-MAY-88	215	L.0004
108	00NF02YG0001	805109	05-MAY-88	215	L.0004
109	00NF02YL0012	805110	05-MAY-88	215	L.0004
110	00NF02YD0021	805099	05-MAY-88	215	L.0004
111	00NF02ZM0009	805133	05-MAY-88	215	L.0004
112	00NF02ZM0020	805132	06-MAY-88	215	L.0004

0	1 STN	2 SAMPLE	3 SDATE	4 SUBID	5 HCB
113	00NF02ZC0001	805116	16-MAY-88	215	L.0004
114	00NF02ZK0001	805135	16-MAY-88	215	L.0004
115	00NF02ZK0005	805134	16-MAY-88	215	L.0004
116	00NF02ZN0004	805136	16-MAY-88	215	L.0004
117	00NF02ZN0004	805137	16-MAY-88	215	L.0004
118	00NF02YQ0005	805150	17-MAY-88	215	L.0004
119	00NF02YQ0005	805151	17-MAY-88	215	L.0004
120	00NF02YC0002	805123	18-MAY-88	215	L.0004
121	00NF02YC0002	805140	18-MAY-88	215	L.0004
122	00NF02YH0018	805121	18-MAY-88	215	L.0004
123	00NF02ZS0025	805139	18-MAY-88	215	L.0004
124	00NF02ZH0010	805138	18-MAY-88	215	L.0004
125	00NF02YE0004	805125	19-MAY-88	215	L.0004
126	00NF02YE0005	805127	19-MAY-88	215	L.0004
127	00NF02YS0011	805152	19-MAY-88	215	L.0004
128	00NF02ZS0016	805170	19-MAY-88	215	L.0004
129	00NF02ZS0024	805171	19-MAY-88	215	L.0004
130	00NF02YL0013	805129	20-MAY-88	215	L.0004
131	00NF02YL0013	805130	20-MAY-88	215	L.0004
132	00NF02YR0001	805153	25-MAY-88	215	L.0004
133	00NF02YR0001	805154	25-MAY-88	215	L.0004
134	00NF02YS0005	805156	26-MAY-88	215	L.0004
135	00NF02YS0010	805155	26-MAY-88	215	L.0004
136	00NF02ZM0019	805172	26-MAY-88	215	L.0004
137	00NF02ZM0015	805173	30-MAY-88	215	L.0004
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653	02NS01DC0004	2225	23-SEP-80	211	L.002
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655	02NB01AP0013	100861	13-JUL-81	211	L.002
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692	02NF02YD0001	202452	22-OCT-82	211	L.002
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732	03PE01CE0002	101228	29-JUL-81	211	L.002
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736	03PE01CB0007	101232	30-JUL-81	211	L.002
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772	05NF02ZB0001	801135	15-JUN-88	211	L.002
773	05NF02ZB0001	801136	15-JUN-88	211	L.002
774	05NS01DC0001	801063	16-JUN-88	211	L.002
775	05NS01DC0001	801064	16-JUN-88	211	L.002
776	05NS01DC0002	801065	16-JUN-88	211	L.002
777	05NS01DC0002	801066	16-JUN-88	211	L.002
778	05NS01DC0001	802581	18-OCT-88	211	L.002
779	05NS01DC0001	802582	18-OCT-88	211	L.002
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781	05NS01DC0002	802584	18-OCT-88	211	L.002
782	05NF02YE0001	802696	25-OCT-88	211	L.002
783	05NF02YE0001	802697	25-OCT-88	211	L.002
784	05NF02ZB0001	802708	25-OCT-88	211	L.002

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789	10PE01CC0054	600521	20-MAY-86	211	L.002
790	10PE01CC0055	600522	20-MAY-86	211	L.002
791	10PE01CC0055	600523	20-MAY-86	211	L.002
792	10PE01CB0017	600526	21-MAY-86	211	L.002
793	10PE01CB0017	600527	21-MAY-86	211	L.002
794	10PE01CB0018	600524	21-MAY-86	211	L.002
795	10PE01CB0018	600525	21-MAY-86	211	L.002
796	10PE01CB0019	600528	21-MAY-86	211	L.002
797	10PE01CB0019	600529	21-MAY-86	211	L.002
798	10PE01CB0020	600530	21-MAY-86	211	L.002
799	10PE01CB0020	600531	21-MAY-86	211	L.002
800	10PE01CC0053	600519	22-MAY-86	211	L.002
801	10PE01CC0056	600536	22-MAY-86	211	L.002
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804	10PE01CD0002	600533	22-MAY-86	211	L.002
805	10PE01CE0007	600534	22-MAY-86	211	L.002
806	10PE01CE0007	600535	22-MAY-86	211	L.002
807	10NS01DP0005	600804	03-JUN-86	211	L.002
808	10NS01DP0005	600805	03-JUN-86	211	L.002
809	10NS01DH0002	600808	04-JUN-86	211	L.002
810	10NS01DH0002	600809	04-JUN-86	211	L.002
811	10NS01DC0002	600816	05-JUN-86	211	L.002
812	10NS01DC0002	600817	05-JUN-86	211	L.002
813	10NS01DD0005	600824	05-JUN-86	211	L.002
814	10NS01DD0005	600825	05-JUN-86	211	L.002
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817	10NB01AK0042	600951	10-JUN-86	211	L.002
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819	10NB01AR0001	600949	10-JUN-86	211	L.002
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823	10NB01BA0001	600957	12-JUN-86	211	L.002
824	10NB01BA0001	600958	12-JUN-86	211	L.002
825	10NB01BD0006	600961	12-JUN-86	211	L.002
826	10NB01BD0006	600962	12-JUN-86	211	L.002
827	10NB01BT0003	600963	13-JUN-86	211	L.002
828	10NB01BT0003	600964	13-JUN-86	211	L.002
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832	10PE01CC0054	601804	09-SEP-86	211	L.002
833	10PE01CC0055	601805	09-SEP-86	211	L.002
834	10PE01CC0055	601806	09-SEP-86	211	L.002
835	10PE01CB0017	601809	10-SEP-86	211	L.002
836	10PE01CB0017	601810	10-SEP-86	211	L.002
837	10PE01CB0018	601807	10-SEP-86	211	L.002
838	10PE01CB0018	601808	10-SEP-86	211	L.002
839	10PE01CB0019	601811	10-SEP-86	211	L.002
840	10PE01CB0019	601812	10-SEP-86	211	L.002

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842	10PE01CB0020	601814	10-SEP-86	211	L.002
843	10PE01CC0056	601817	11-SEP-86	211	L.002
844	10PE01CC0056	601818	11-SEP-86	211	L.002
845	10PE01CD0002	601815	11-SEP-86	211	L.002
846	10PE01CD0002	601816	11-SEP-86	211	L.002
847	10PE01CE0007	601840	17-SEP-86	211	L.002
848	10PE01CE0007	601839	17-SEP-86	211	L.002
849	10NS01DP0005	601957	22-SEP-86	211	L.002
850	10NS01DP0005	601958	22-SEP-86	211	L.002
851	10NS01DH0002	601961	23-SEP-86	211	L.002
852	10NS01DH0002	601962	23-SEP-86	211	L.002
853	10NS01DC0002	601967	24-SEP-86	211	L.002
854	10NS01DC0002	601968	24-SEP-86	211	L.002
855	10NS01DD0005	601973	24-SEP-86	211	L.002
856	10NS01DD0005	601974	24-SEP-86	211	L.002
857	10NS01DD0006	601971	24-SEP-86	211	L.002
858	10NS01DD0006	601972	24-SEP-86	211	L.002
859	10NB01AR0001	602333	21-OCT-86	211	L.002
860	10NB01AR0001	602332	21-OCT-86	211	L.002
861	10NB01AK0042	602334	22-OCT-86	211	L.002
862	10NB01AK0042	602335	22-OCT-86	211	L.002
863	10NB01AF0020	602338	23-OCT-86	211	L.002
864	10NB01AF0020	602339	23-OCT-86	211	L.002
865	10NB01BA0001	602340	23-OCT-86	211	L.002
866	10NB01BA0001	602341	23-OCT-86	211	L.002
867	10NB01BD0006	602344	24-OCT-86	211	L.002
868	10NB01BD0006	602345	24-OCT-86	211	L.002
869	10NB01BT0003	602349	27-OCT-86	211	L.002
870	10NB01BT0003	602350	27-OCT-86	211	L.002
871	10PE01CC0057	700471	19-MAY-87	211	L.002
872	10PE01CC0057	700472	19-MAY-87	211	L.002
873	10PE01CC0056	700474	20-MAY-87	211	L.002
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875	10PE01CC0058	700475	20-MAY-87	211	L.002
876	10PE01CC0058	700476	20-MAY-87	211	L.002
877	10PE01CC0059	700477	20-MAY-87	211	L.002
878	10PE01CC0059	700478	20-MAY-87	211	L.002
879	10PE01CD0003	700479	20-MAY-87	211	L.002
880	10PE01CD0003	700480	20-MAY-87	211	L.002
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883	10PE01CB0018	700487	21-MAY-87	211	L.002
884	10PE01CB0018	700488	21-MAY-87	211	L.002
885	10PE01CB0020	700483	21-MAY-87	211	L.002
886	10PE01CB0020	700484	21-MAY-87	211	L.002
887	10PE01CB0021	700485	21-MAY-87	211	L.002
888	10PE01CB0021	700486	21-MAY-87	211	L.002
889	10PE01CC0060	700481	21-MAY-87	211	L.002
890	10PE01CC0060	700482	21-MAY-87	211	L.002
891	10NB01BC0001	700643	25-MAY-87	211	L.002
892	10NB01BC0001	700644	25-MAY-87	211	L.002
893	10NB01AF0021	700647	26-MAY-87	211	L.002
894	10NB01AF0021	700648	26-MAY-87	211	L.002
895	10NB01AJ0007	700649	26-MAY-87	211	L.002
896	10NB01AJ0007	700650	26-MAY-87	211	L.002

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899	10NB01AK0006	700655	27-MAY-87	211	L.002
900	10NB01AK0006	700656	27-MAY-87	211	L.002
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902	10NB01AK0011	700652	27-MAY-87	211	L.002
903	10NB01AK0028	700657	27-MAY-87	211	L.002
904	10NB01AK0028	700658	27-MAY-87	211	L.002
905	10NB01AP0001	700661	27-MAY-87	211	L.002
906	10NB01AP0001	700662	27-MAY-87	211	L.002
907	10NB01AP0002	700659	27-MAY-87	211	L.002
908	10NB01AP0002	700660	27-MAY-87	211	L.002
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912	10PE01CC0058	702533	15-SEP-87	211	L.002
913	10PE01CC0059	702534	15-SEP-87	211	L.002
914	10PE01CC0059	702535	15-SEP-87	211	L.002
915	10PE01CC0056	702538	16-SEP-87	211	L.002
916	10PE01CC0056	702539	16-SEP-87	211	L.002
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918	10PE01CC0060	702543	16-SEP-87	211	L.002
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921	10PE01CB0017	702548	17-SEP-87	211	L.002
922	10PE01CB0017	702549	17-SEP-87	211	L.002
923	10PE01CB0018	702546	17-SEP-87	211	L.002
924	10PE01CB0018	702547	17-SEP-87	211	L.002
925	10PE01CB0020	702544	17-SEP-87	211	L.002
926	10PE01CB0020	702545	17-SEP-87	211	L.002
927	10PE01CB0021	702550	17-SEP-87	211	L.002
928	10PE01CB0021	702551	17-SEP-87	211	L.002
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931	10NB01AF0021	702769	06-OCT-87	211	L.002
932	10NB01AF0021	702770	06-OCT-87	211	L.002
933	10NB01AJ0007	702771	06-OCT-87	211	L.002
934	10NB01AJ0007	702772	06-OCT-87	211	L.002
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936	10NB01AK0003	702776	07-OCT-87	211	L.002
937	10NB01AK0006	702777	07-OCT-87	211	L.002
938	10NB01AK0006	702778	07-OCT-87	211	L.002
939	10NB01AK0011	702773	07-OCT-87	211	L.002
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945	10NB01AP0002	702781	07-OCT-87	211	L.002
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951	10PE01CC0061	800606	17-MAY-88	211	L.002
952	10PE01CC0061	800607	17-MAY-88	211	L.002

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955	10PE01CE0007	800610	18-MAY-88	211	L.002
956	10PE01CE0007	800611	18-MAY-88	211	L.002
957	10PE01CB0017	800618	19-MAY-88	211	L.002
958	10PE01CB0017	800619	19-MAY-88	211	L.002
959	10PE01CB0018	800616	19-MAY-88	211	L.002
960	10PE01CB0018	800617	19-MAY-88	211	L.002
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962	10PE01CB0020	800615	19-MAY-88	211	L.002
963	10PE01CB0022	800620	19-MAY-88	211	L.002
964	10PE01CB0022	800621	19-MAY-88	211	L.002
965	10PE01CC0060	800612	19-MAY-88	211	L.002
966	10PE01CC0060	800613	19-MAY-88	211	L.002
967	10NB01BU0003	800725	30-MAY-88	211	L.002
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969	10NB01BL0038	800729	31-MAY-88	211	L.002
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971	10NB01BL0039	800732	31-MAY-88	211	L.002
972	10NB01BL0039	800731	31-MAY-88	211	L.002
973	10NB01BL0040	800733	31-MAY-88	211	L.002
974	10NB01BL0040	800734	31-MAY-88	211	L.002
975	10NB01BD0007	800727	31-MAY-88	211	L.002
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977	10NB01AF0022	800741	01-JUN-88	211	L.002
978	10NB01AF0022	800742	01-JUN-88	211	L.002
979	10NB01AF0023	800739	01-JUN-88	211	L.002
980	10NB01AF0023	800740	01-JUN-88	211	L.002
981	10NB01AF0024	800743	01-JUN-88	211	L.002
982	10NB01AF0024	800744	01-JUN-88	211	L.002
983	10NB01BJ0001	800737	01-JUN-88	211	L.002
984	10NB01BJ0001	800738	01-JUN-88	211	L.002
985	10NB01BJ0002	800735	01-JUN-88	211	L.002
986	10NB01BJ0002	800736	01-JUN-88	211	L.002
987	10NS01DB0004	801071	16-JUN-88	211	L.002
988	10NS01DB0004	801072	16-JUN-88	211	L.002
989	10NS01DC0003	801067	16-JUN-88	211	L.002
990	10NS01DC0003	801068	16-JUN-88	211	L.002
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993	10PE01CB0020	802092	19-SEP-88	211	L.002
994	10PE01CB0020	802093	19-SEP-88	211	L.002
995	10PE01CC0060	802090	19-SEP-88	211	L.002
996	10PE01CC0060	802091	19-SEP-88	211	L.002
997	10NB01BL0038	802044	20-SEP-88	211	L.002
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1002	10NB01BL0040	802049	20-SEP-88	211	L.002
1003	10NB01BD0007	802042	20-SEP-88	211	L.002
1004	10NB01BD0007	802043	20-SEP-88	211	L.002
1005	10PE01CD0004	802094	20-SEP-88	211	L.002
1006	10PE01CD0004	802095	20-SEP-88	211	L.002
1007	10PE01CE0007	802096	20-SEP-88	211	L.002
1008	10PE01CE0007	802097	20-SEP-88	211	L.002

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1013	10NB01AF0024	802058	21-SEP-88	211	L.002
1014	10NB01AF0024	802059	21-SEP-88	211	L.002
1015	10NB01BJ0001	802050	21-SEP-88	211	L.002
1016	10NB01BJ0001	802051	21-SEP-88	211	L.002
1017	10NB01BJ0002	802052	21-SEP-88	211	L.002
1018	10NB01BJ0002	802053	21-SEP-88	211	L.002
1019	10PE01CB0017	802100	21-SEP-88	211	L.002
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1023	10PE01CB0022	802103	21-SEP-88	211	L.002
1024	10PE01CB0022	802102	21-SEP-88	211	L.002
1025	10PE01CC0056	802104	22-SEP-88	211	L.002
1026	10PE01CC0056	802105	22-SEP-88	211	L.002
1027	10PE01CC0058	802106	22-SEP-88	211	L.002
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1030	10PE01CC0061	802109	22-SEP-88	211	L.002
1031	10NS01DB0004	802585	18-OCT-88	211	L.002
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1034	10NS01DC0003	802590	18-OCT-88	211	L.002
1035	10PE01CB0124	900651	06-JUN-89	211	L.002
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1039	10PE01CC0185	900653	06-JUN-89	211	L.002
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1077	33PE01CA0001	3123	27-OCT-80	162	L.002
1078	33NS01ED0004	3122	28-OCT-80	162	L.002
1079	33NS01ED0004	3423	01-NOV-80	162	L.002
1080	33NS01ED0004	3422	01-NOV-80	162	L.002
1081	33PE01CA0001	3421	30-NOV-80	162	L.002
1082	33NS01ED0004	3615	19-DEC-80	162	L.002
1083	33PE01CA0001	3647	31-DEC-80	162	L.002
1084	33NS01ED0004	3920	31-JAN-81	162	L.002
1085	33PE01CA0001	3921	31-JAN-81	162	L.002
1086	33NS01ED0004	4119	27-FEB-81	162	L.002
1087	33PE01CA0001	4118	27-FEB-81	162	L.002
1088	33PE01CA0001	100008	30-MAR-81	162	L.002
1089	33NS01ED0004	100009	31-MAR-81	162	L.002
1090	33NS01ED0004	100010	31-MAR-81	162	L.002
1091	33NS01ED0004	100170	01-APR-81	162	L.002
1092	33NS01ED0004	100518	01-MAY-81	162	L.002
1093	33PE01CA0001	100516	01-MAY-81	162	L.002
1094	33NS01ED0004	101092	01-JUN-81	162	L.002
1095	33NS01ED0004	101093	01-JUN-81	162	L.002
1096	33PE01CA0001	101400	01-JUN-81	162	L.002
1097	33PE01CA0001	101401	01-JUN-81	162	L.002
1098	33PE01CA0001	101473	01-JUL-81	162	L.002
1099	33NS01ED0004	101402	22-JUL-81	162	L.002
1100	33NS01ED0004	101622	31-AUG-81	162	L.002
1101	33NS01ED0004	101623	31-AUG-81	162	L.002
1102	33PE01CA0001	101621	31-AUG-81	162	L.002
1103	33NS01ED0004	102118	30-SEP-81	162	L.002
1104	33PE01CA0001	102119	30-SEP-81	162	L.002
1105	33NS01ED0004	102400	25-OCT-81	162	L.002
1106	33NS01ED0004	102686	23-NOV-81	162	L.002
1107	33PE01CA0001	102684	30-NOV-81	162	L.002
1108	33NS01ED0004	102859	31-DEC-81	162	L.002
1109	33PE01CA0001	102858	31-DEC-81	162	L.002
1110	33NS01ED0004	103133	31-JAN-82	162	L.002
1111	33PE01CA0001	103100	31-JAN-82	162	L.002
1112	33NS01ED0004	200036	31-MAR-82	162	L.002
1113	33NS01ED0004	200230	30-APR-82	162	L.002
1114	33PE01CA0001	200259	30-APR-82	162	L.002
1115	33NS01ED0004	200486	31-MAY-82	162	L.002
1116	33PE01CA0001	200604	31-MAY-82	162	L.002
1117	33NS01ED0004	200944	30-JUN-82	162	L.002
1118	33PE01CA0001	200943	30-JUN-82	162	L.002
1119	33NS01ED0004	201196	31-JUL-82	162	L.002
1120	33PE01CA0001	201206	31-JUL-82	162	L.002

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1123	33NS01ED0004	201973	30-SEP-82	162	L.002
1124	33PE01CA0001	202041	30-SEP-82	162	L.002
1125	33NS01ED0004	202207	31-OCT-82	162	L.002
1126	33PE01CA0001	202184	31-OCT-82	162	L.002
1127	33PE01CA0001	102402	03-NOV-82	162	L.002
1128	33NS01ED0004	202491	30-NOV-82	162	L.002
1129	33PE01CA0001	202498	30-NOV-82	162	L.002
1130	33NS01ED0004	202782	31-DEC-82	162	L.002
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1132	33NS01ED0004	202920	31-JAN-83	162	L.002
1133	33PE01CA0001	202921	31-JAN-83	162	L.002
1134	33NS01ED0004	203176	28-FEB-83	162	L.002
1135	33PE01CA0001	203177	28-FEB-83	162	L.002
1136	33PE01CA0001	300077	28-MAR-83	162	L.002
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1139	33PE01CA0001	300243	01-MAY-83	162	L.002
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1148	33NS01ED0004	301996	30-SEP-83	162	L.002
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1152	33NS01ED0004	303178	30-NOV-83	162	L.002
1153	33NS01ED0004	303321	31-DEC-83	162	L.002
1154	33PE01CA0001	303322	31-DEC-83	162	L.002
1155	33NS01ED0004	400002	31-MAR-84	162	L.002
1156	33PE01CA0001	400003	31-MAR-84	162	L.002
1157	33NS01ED0004	400201	30-APR-84	162	L.002
1158	33PE01CA0001	400202	30-APR-84	162	L.002
1159	33NS01ED0004	400645	31-MAY-84	162	L.002
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1161	33NS01ED0004	401248	30-JUN-84	162	L.002
1162	33PE01CA0001	401175	30-JUN-84	162	L.002
1163	33NS01ED0004	401606	31-JUL-84	162	L.002
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1165	33NS01ED0004	402035	31-AUG-84	162	L.002
1166	33PE01CA0001	402046	31-AUG-84	162	L.002
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1168	33PE01CA0001	402460	30-SEP-84	162	L.002
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1173	33PE01CA0001	403268	30-NOV-84	162	L.002
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1202	33PE01CA0001	501620	30-SEP-85	162	L.002
1203	33PE01CA0001	502002	30-OCT-85	162	L.002
1204	33NS01DN0001	502061	31-OCT-85	162	L.002
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1216	33NS01ED0004	600067	31-MAR-86	162	L.002
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1218	33NS01DN0001	600326	30-APR-86	162	L.002
1219	33NS01ED0004	600348	30-APR-86	162	L.002
1220	33PE01CA0001	600349	30-APR-86	162	L.002
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1223	33PE01CA0001	600771	02-JUN-86	162	L.002
1224	33NS01DN0001	601155	30-JUN-86	162	L.002
1225	33NS01ED0004	601153	30-JUN-86	162	L.002
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1227	33NS01DN0001	601431	31-JUL-86	162	L.002
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1229	33PE01CA0001	601430	31-JUL-86	162	L.002
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1231	33NS01ED0004	601703	31-AUG-86	162	L.002
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1240	33NS01ED0004	602545	30-NOV-86	162	L.002
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1242	33NS01ED0004	602768	31-DEC-86	162	L.002
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1246	33NS01ED0004	603063	28-FEB-87	162	L.002
1247	33NS01DN0001	700001	31-MAR-87	162	L.002
1248	33NS01ED0004	700048	31-MAR-87	162	L.002
1249	33NS01DN0001	700357	30-APR-87	162	L.002
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1251	33NS01DN0001	700831	31-MAY-87	162	L.002
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1253	33NS01DN0001	701334	30-JUN-87	162	L.002
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1255	33NS01DN0001	701692	31-JUL-87	162	L.002
1256	33NS01ED0004	701691	31-JUL-87	162	L.002
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1260	33NS01ED0004	702735	30-SEP-87	162	L.002
1261	33NS01DN0001	703167	31-OCT-87	162	L.002
1262	33NS01DN0002	703168	31-OCT-87	162	L.002
1263	33NS01ED0004	703166	31-OCT-87	162	L.002
1264	33NS01DN0001	703587	26-NOV-87	162	L.002
1265	33NS01DN0002	703588	26-NOV-87	162	L.002
1266	33NS01ED0004	703663	30-NOV-87	162	L.002
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1268	33NS01DN0002	703765	31-DEC-87	162	L.002
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1276	33NS01DN0001	800116	31-MAR-88	162	L.002
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1278	33NS01ED0004	800115	31-MAR-88	162	L.002
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1280	33NS01DN0002	800287	23-APR-88	162	L.002
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1289	33NS01ED0004	801342	30-JUN-88	162	L.002
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1292	33NS01ED0004	801563	31-JUL-88	162	L.002
1293	33NS01DN0001	801825	31-AUG-88	162	L.002
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1296	33NS01DN0001	802403	30-SEP-88	162	L.002
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1303	33NS01DN0002	803001	30-NOV-88	162	L.002
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1307	33NS01ED0004	803163	31-DEC-88	162	L.002
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1309	33NS01DN0002	803418	31-JAN-89	162	L.002
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1312	33NS01DN0002	803514	28-FEB-89	162	L.002
1313	33NS01ED0004	803521	28-FEB-89	162	L.002
1314	33NS01DN0001	803650	28-MAR-89	162	L.002
1315	33NS01DN0002	900001	31-MAR-89	162	L.002
1316	33NS01ED0004	900019	31-MAR-89	162	L.002
1317	33NS01DN0001	900222	30-APR-89	162	L.002
1318	33NS01DN0002	900223	30-APR-89	162	L.002
1319	33NS01ED0004	900236	30-APR-89	162	L.002
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1321	33NS01DN0002	900565	31-MAY-89	162	L.002
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1326	33NS01ED0004	901441	31-JUL-89	162	L.002
1327	33NS01DN0001	901953	31-AUG-89	162	L.002
1328	33NS01ED0004	901924	31-AUG-89	162	L.002
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1332	33NS01ED0004	902795	31-OCT-89	162	L.002
1333	33NS01DN0001	903178	30-NOV-89	162	L.002
1334	33NS01ED0004	903122	30-NOV-89	162	L.002
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1339	50NS01DC0084	301149	28-SEP-82	211	L.0002
1340	50NS01DC0084	301150	28-SEP-82	211	L.0002
1341	50NS01DD0037	302543	28-SEP-82	211	L.0002
1342	50NS01DD0037	302544	28-SEP-82	211	L.0002
1343	50NS01DD0037	302556	28-SEP-82	211	L.0002
1344	50NS01DD0037	302557	28-SEP-82	211	L.0002

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1348	50NF02YN0007	705649	22-SEP-87	216	L.004
1349	50NF02YN0007	705650	22-SEP-87	216	L.004
1350	50NF02YN0007	705651	22-SEP-87	216	L.004
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1359	51NB01AJ0003	4724	24-JUN-80	211	L.0002
1360	51NB01AG0001	4725	25-JUN-80	211	L.0002
1361	51NB01AG0001	4726	25-JUN-80	211	L.0002
1362	51NB01AG0001	4727	25-JUN-80	211	L.0002
1363	51NS01FB0002	2601	22-OCT-80	211	L.0002
1364	51NS01FB0002	2602	22-OCT-80	211	L.0002
1365	51NS01FB0002	2603	22-OCT-80	211	L.0002
1366	51NB01AF0006	301137	22-JUN-82	211	L.0002
1367	51NB01AF0006	301138	22-JUN-82	211	L.0002
1368	51NB01AF0006	301139	22-JUN-82	211	L.0002
1369	51NB01AG0002	301140	22-JUN-82	211	L.0002
1370	51NB01AG0002	301141	22-JUN-82	211	L.0002
1371	51NB01AG0002	301142	22-JUN-82	211	L.0002
1372	51PE01CA0001	301144	13-JUL-82	211	L.0002
1373	51PE01CA0001	301145	13-JUL-82	211	L.0002
1374	51PE01CA0001	302549	13-JUL-82	211	L.0002
1375	51PE01CC0004	302552	14-JUL-82	211	L.0002
1376	51PE01CE0003	301146	14-JUL-82	211	L.0002
1377	51PE01CE0003	302551	14-JUL-82	211	L.0002
1378	51PE01CE0003	302555	14-JUL-82	211	L.0002
1379	51NS01FG0021	301154	30-SEP-82	211	L.0002
1380	51NS01FG0022	301153	30-SEP-82	211	L.0002
1381	51NS01FG0023	301152	30-SEP-82	211	L.0002
1382	51NS01FG0024	301151	30-SEP-82	211	L.0002
1383	51NF02YL0009	301158	14-OCT-82	211	L.0002
1384	51NF02YL0009	302553	14-OCT-82	211	L.0002
1385	51NF02YN0013	301159	16-OCT-82	211	L.0002
1386	51NF02YQ0014	302546	18-OCT-82	211	L.0002
1387	51NF02YS0060	301162	19-OCT-82	211	L.0002
1388	51PE01CA0002	302550	13-JUL-83	211	L.0002
1389	51NF02YC0002	705969	27-AUG-87	215	L.004
1390	51NF02YC0002	705970	27-AUG-87	215	L.004
1391	51NF02YC0002	705971	27-AUG-87	215	L.004
1392	51NF02YC0003	705972	27-AUG-87	215	L.004
1393	51NF02YC0003	705973	27-AUG-87	215	L.004
1394	51NF02YC0003	705974	27-AUG-87	215	L.004
1395	51NF02YC0005	705967	27-AUG-87	215	L.004
1396	51NF02YC0005	705968	27-AUG-87	215	L.004
1397	51NF02YC0005	705990	27-AUG-87	215	L.004
1398					
1399	52NS01DC0004	103915	22-SEP-81	211	0.0004
1400	52NS01DC0004	103916	22-SEP-81	211	0.0004

0	1 STN	2 SAMPLE	3 SDATE	4 SUBID	5 HCB
1401	52NS01DC0004	103917	22-SEP-81	211	0.0004
1402	52NS01DC0001	103912	22-SEP-81	211	0.0010
1403	52NS01DC0001	103913	22-SEP-81	211	0.0010
1404	52NS01DC0001	103914	22-SEP-81	211	0.0010
1405	52NB01BD0001	4475	10-JUN-80	211	L.0002
1406	52NB01BD0001	4476	10-JUN-80	211	L.0002
1407	52NB01BD0001	4477	10-JUN-80	211	L.0002
1408	52NB01BK0001	4478	11-JUN-80	211	L.0002
1409	52NB01BK0001	4479	11-JUN-80	211	L.0002
1410	52NB01BK0001	4480	11-JUN-80	211	L.0002
1411	52NB01AR0002	4729	25-JUN-80	211	L.0002
1412	52NB01AR0002	4728	25-JUN-80	211	L.0002
1413	52NB01AR0002	4730	25-JUN-80	211	L.0002
1414	52NB01AP0012	4732	26-JUN-80	211	L.0002
1415	52NB01AP0012	4733	26-JUN-80	211	L.0002
1416	52NS01DC0004	2604	23-SEP-80	211	L.0002
1417	52NS01DC0004	2606	23-SEP-80	211	L.0002
1418	52NS01DC0004	2605	23-OCT-80	211	L.0002
1419	52NS01DC0004	301147	28-SEP-82	211	L.0002
1420	52NF02YD0001	301160	22-OCT-82	211	L.0002
1421	52NF02YD0001	301161	22-OCT-82	211	L.0002
1422	52NB01BS0005	200519	31-MAY-82	211	L.002
1423	52NB01BS0005	200520	31-MAY-82	211	L.002
1424	52NB01BS0006	200521	31-MAY-82	211	L.002
1425	52NB01BS0006	200522	31-MAY-82	211	L.002
1426	52NB01BS0006	200523	31-MAY-82	211	L.002
1427	52NF02YD0004	705652	26-SEP-87	216	L.004
1428	52NF02YD0004	705653	26-SEP-87	216	L.004
1429	52NF02YD0004	705654	26-SEP-87	216	L.004
1430	52NF02YD0002	705657	29-SEP-87	216	L.004
1431	52NF02YD0002	705658	29-SEP-87	216	L.004
1432					
1433	53NB01BJ0001	4483	11-JUN-80	211	0.0060
1434	53NB01BJ0001	4482	11-JUN-80	211	0.0070
1435	53NB01BJ0001	4481	11-JUN-80	211	0.0100
1436	53PE01CC0005	1301	29-JUL-80	211	L.0002
1437	53PE01CC0005	1302	29-JUL-80	211	L.0002
1438	53PE01CC0005	1303	29-JUL-80	211	L.0002
1439	53PE01CB0005	1307	31-JUL-80	211	L.0002
1440	53PE01CB0006	1304	31-JUL-80	211	L.0002
1441	53PE01CB0006	1305	31-JUL-80	211	L.0002
1442	53PE01CB0006	1306	31-JUL-80	211	L.0002
1443	53NF02YK0001	1924	21-AUG-80	211	L.0002
1444	53NF02YK0001	1925	21-AUG-80	211	L.0002
1445	53NF02YK0001	1926	21-AUG-80	211	L.0002
1446	53NF02YD0001	1927	24-AUG-80	211	L.0002
1447	53NF02ZM0001	1928	27-AUG-80	211	L.0002
1448	53NF02ZM0001	1929	27-AUG-80	211	L.0002
1449	53NS01ED0001	2607	24-SEP-80	211	L.0002
1450	53NS01ED0001	2608	24-SEP-80	211	L.0002
1451	53NS01ED0001	2609	24-SEP-80	211	L.0002
1452	53NS01EF0002	2610	24-SEP-80	211	L.0002
1453	53NS01EF0002	2611	24-SEP-80	211	L.0002
1454	53NS01EF0002	2612	24-SEP-80	211	L.0002
1455	53NS01EJ0015	2613	25-SEP-80	211	L.0002
1456	53NS01EJ0015	2614	25-SEP-80	211	L.0002

0	1 STN	2 SAMPLE	3 SDATE	4 SUBID	5 HCB
1457	53NS01EJ0015	2615	25-SEP-80	211	L.0002
1458	53NS01ER0001	2595	21-OCT-80	211	L.0002
1459	53NS01ER0001	2596	21-OCT-80	211	L.0002
1460	53NS01ER0001	2597	21-OCT-80	211	L.0002
1461	53NS01FJ0001	2599	22-OCT-80	211	L.0002
1462	53NS01FJ0001	2600	22-OCT-80	211	L.0002
1463	53NS01FJ0001	2598	22-OCT-80	211	L.0002
1464	53NF02ZB0001	301155	13-OCT-82	211	L.0002
1465	53NF02ZB0001	301157	13-OCT-82	211	L.0002
1466	53NF02ZM0003	301163	20-OCT-82	211	L.0002
1467	53NF02ZM0003	302547	20-OCT-82	211	L.0002
1468	53NF02ZM0003	302554	20-OCT-82	211	L.0002
1469	53NF02ZM0004	301164	20-OCT-82	211	L.0002
1470	53NF02ZB0001	301156	13-OCT-82	211	L.0007
1471	53NF02YJ0001	1717	20-AUG-80	211	L.002
1472	53NB01BS0004	200524	31-MAY-82	211	L.002
1473	53NB01BS0004	200525	31-MAY-82	211	L.002
1474	53NB01BS0004	200526	31-MAY-82	211	L.002
1475	53NB01BS0005	200527	31-MAY-82	211	L.002
1476	53NB01BS0005	200528	31-MAY-82	211	L.002
1477	53NB01BS0005	200529	31-MAY-82	211	L.002
1478	53NB01BS0006	200530	31-MAY-82	211	L.002
1479	53NB01BS0006	200531	31-MAY-82	211	L.002
1480	53NB01BS0006	200532	31-MAY-82	211	L.002
1481	53NF02YJ0002	705975	26-AUG-87	215	L.004
1482	53NF02YJ0002	705976	26-AUG-87	215	L.004
1483	53NF02YJ0002	705977	26-AUG-87	215	L.004
1484	53NF02YH0001	705984	28-AUG-87	215	L.004
1485	53NF02YH0001	705985	28-AUG-87	215	L.004
1486	53NF02YH0001	705986	28-AUG-87	215	L.004
1487	53NF02YH0002	705987	28-AUG-87	215	L.004
1488	53NF02YH0002	705988	28-AUG-87	215	L.004
1489	53NF02YH0002	705989	28-AUG-87	215	L.004
1490	53NF02YL0001	705981	28-AUG-87	215	L.004
1491	53NF02YL0001	705982	28-AUG-87	215	L.004
1492	53NF02YL0001	705983	28-AUG-87	215	L.004
1493					
1494	90NB01AP0034	7863	09-MAY-79	900	0.0007
1495	90PE01CE0001	7874	07-MAY-79	900	0.0010
1496	90NB01AP0033	7852	09-MAY-79	900	0.0018
1497	90NS01DD0007	7873	07-MAY-79	900	0.0019
1498	90NB01AP0033	7850	09-MAY-79	900	0.0020
1499	90NS01DD0007	7866	07-MAY-79	900	0.0027
1500	90NS01DD0007	7869	07-MAY-79	900	0.0027
1501	90NB01AP0033	7853	09-MAY-79	900	0.0028
1502	90NB01AP0033	7846	09-MAY-79	900	0.0032
1503	90NS01DD0007	7870	07-MAY-79	900	0.0034
1504	90NB01AP0034	7854	09-MAY-79	900	0.0035
1505	90NB01AP0033	7848	09-MAY-79	900	0.0042
1506	90NS01DD0007	7871	07-MAY-79	900	0.0043
1507	90NB01AP0034	7857	09-MAY-79	900	0.0044
1508	90NB01AP0033	7844	09-MAY-79	900	0.0058
1509	90NB01AP0033	7845	09-MAY-79	900	0.0060
1510	90NB01AP0034	7859	09-MAY-79	900	0.0063
1511	90NS01DD0008	7885	05-JUN-79	900	0.0069
1512	90NB01AP0034	7861	09-MAY-79	900	0.0075

0	1 STN	2 SAMPLE	3 SDATE	4 SUBID	5 HCB
1513	90NS01DD0007	7872	07-MAY-79	900	0.0079
1514	90NS01DD0008	7886	05-JUN-79	900	0.0079
1515	90NB01AP0033	7849	09-MAY-79	900	0.0094
1516	90NS01DD0008	7881	05-JUN-79	900	0.0099
1517	90NS01DD0007	7868	07-MAY-79	900	0.0110
1518	90PE01CE0001	7876	07-MAY-79	900	0.0110
1519	90NB01AP0034	7855	09-MAY-79	900	0.0110
1520	90NB01AP0034	7862	09-MAY-79	900	0.0110
1521	90NS01DD0008	7887	05-JUN-79	900	0.0110
1522	90NS01DD0008	7888	05-JUN-79	900	0.0110
1523	90PE01CE0001	7880	07-MAY-79	900	0.0120
1524	90NB01AP0033	7847	09-MAY-79	900	0.0130
1525	90NB01AP0034	7860	09-MAY-79	900	0.0130
1526	90NS01DD0008	7884	05-JUN-79	900	0.0154
1527	90NS01DD0007	7867	07-MAY-79	900	0.0160
1528	90PE01CE0001	7879	07-MAY-79	900	0.0160
1529	90NB01AP0034	7856	09-MAY-79	900	0.0180
1530	90NS01DD0007	7865	07-MAY-79	900	0.0190
1531	90NS01DD0008	7882	05-JUN-79	900	0.0220
1532	90NB01AP0033	7851	09-MAY-79	900	0.0290
1533	90NS01DD0007	7864	07-MAY-79	900	0.0300
1534	90PE01CE0001	7877	07-MAY-79	900	0.0310
1535	90PE01CE0001	7878	07-MAY-79	900	0.0380
1536	90NB01AP0034	7858	09-MAY-79	900	0.0410
1537	90NS01DD0008	7883	05-JUN-79	900	0.0460
1538	90PE01CE0001	7875	07-MAY-79	900	0.0620

APPENDIX C

Quality control and non-valid hexachlorobenzene samples.

0	1 STN	2 SAMPLE	3 SDATE	4 HCB	5 % REC
1					
2	BLANKS				
3					
4	00NS000BLANK	500563	28-MAY-85	L.002	-
5	00NS000BLANK	500564	29-MAY-85	L.002	-
6	00NS000BLANK	500565	30-MAY-85	L.002	-
7	00NF000BLANK	500851	20-JUN-85	L.002	-
8	01NS01D09959	600814	04-JUN-86	L.002	-
9	10NB01AF9920	600967	11-JUN-86	L.002	-
10	01NF02YR9918	601098	11-JUN-86	L.002	-
11	01NF02YD9918	601099	12-JUN-86	L.002	-
12	10PE01CD9903	700491	20-MAY-87	L.002	-
13	10NB01BC9901	700666	25-MAY-87	L.002	-
14	00NS01DD9910	701147	18-JUN-87	L.002	-
15	00NF02YD9922	701215	17-JUN-87	L.002	-
16	10PE01CC9956	702535	17-SEP-87	L.002	-
17	10NB01BC9901	702785	05-OCT-87	L.002	-
18	00NF02YD9922	703059	22-OCT-87	L.002	-
19	00NS01DD9910	703141	29-OCT-87	L.002	-
20	10PE01CC9956	800622	19-MAY-88	L.002	-
21	10NB01BU9903	800747	30-MAY-88	L.002	-
22	01NS01EE9952	801073	15-JUN-88	L.002	-
23	05NF02YE9901	801139	15-JUN-88	L.002	-
24	10NB01BU9903	802060	19-SEP-88	L.002	-
25	10PE01CB9918	802110	21-SEP-88	L.002	-
26	01NS01ED9962	802597	19-OCT-88	L.002	-
27	01NF02YA9906	802712	26-OCT-88	L.002	-
28	10PE01CE9983	900663	06-JUN-89	L.002	-
29	10PE01CE9983	902378	03-OCT-89	L.002	-
30	00NF02ZM9989	905598	14-AUG-89	L.0004	-
31	00NF02ZM9992	905604	14-AUG-89	L.0004	-
32					
33	HCB NOT				
34	SPIKED				
35					
36	00NS01DCFS01	2302	23-SEP-80	L.002	-
37	01NB01BJFS15	500670	06-JUN-85	L.002	-
38	01NB01BJFS15	500671	06-JUN-85	L.002	-
39	01NF02ZGSPIK	500850	20-JUN-85	L.002	-
40	00NB01ADSPIK	501757	09-OCT-85	L.002	-
41	00NB01ADSPIK	501758	09-OCT-85	L.002	-
42	01NS01EBFS03	501936	23-OCT-85	L.002	-
43	01NS01EBFS03	501937	23-OCT-85	L.002	-
44	01NS01EBFS03	501938	23-OCT-85	L.002	-
45	01NF02ZGFS05	502172	07-NOV-85	L.002	-
46	01NF02ZGFS05	502173	07-NOV-85	L.002	-
47	10PE01CCFS35	601819	09-SEP-86	L.002	-
48	01NB01BUFS02	601820	09-SEP-86	L.002	-
49	10PE01CCFD36	702534	17-SEP-87	L.002	-
50					
51	SPIKES				
52					
53	01NB01AGFS02	803	25-JUN-80	0.02000	?
54	02NB01APFS12	806	26-JUN-80	0.02000	?
55	03NF02YNFS01	1738	21-AUG-80	0.01690	?
56	00NF02ZMFS01	1917	25-AUG-80	0.00850	?
57	00NF02ZKFS01	1920	28-AUG-80	0.01740	?
58	03NS01EFFS02	2305	24-SEP-80	0.00220	?
59	00NS01DNFS02	2308	26-SEP-80	0.00270	?
60	01NB01ADFS04	100760	23-JUN-81	0.05200	?
61	01NB01ADFS05	100764	23-JUN-81	0.04300	?
62	01NB01AFFS06	100767	24-JUN-81	0.06700	?
63	01NB01AHFS08	100771	24-JUN-81	0.06100	?
64	01NB01AKFS12	100775	25-JUN-81	0.05900	?
65	01NB01AOFS19	100779	26-JUN-81	0.06300	?
66	01NB01AQFS27	100876	16-JUL-81	0.08500	?
67	01NB01AQFS27	100877	16-JUL-81	0.08900	?
68	01NB01AQFS27	100878	16-JUL-81	0.10200	?
69	03PE01CBFS07	101240	30-JUL-81	0.11300	?
70	03PE01CBFS07	101241	30-JUL-81	0.08000	?
71	03PE01CBFS07	101242	30-JUL-81	0.06700	?
72	03PE01CBFS07	101243	30-JUL-81	0.07400	?
73	01NS01EDFS50	101433	12-AUG-81	0.06500	?
74	01NS01EDFS50	101434	12-AUG-81	0.06200	?
75	01NS01EDFS50	101435	12-AUG-81	0.06100	?
76	01NS01EDFS50	101436	12-AUG-81	0.06200	?
77	02NS01DCFS04	101908	22-SEP-81	0.06000	?
78	02NS01DCFS04	101909	22-SEP-81	0.06500	?
79	02NS01DCFS04	101910	22-SEP-81	0.07500	?
80	02NS01DCFS04	101911	22-SEP-81	0.06500	?
81	03NS01FAFS04	102257	07-OCT-81	0.03000	?
82	03NS01FAFS04	102258	07-OCT-81	0.03400	?
83	03NS01FAFS04	102259	07-OCT-81	0.07800	?
84	03NS01FAFS04	102260	07-OCT-81	0.07600	?
85	10PE01CBFS18	600538	21-MAY-86	0.04200	105.0
86	10PE01CBFS18	600539	21-MAY-86	0.04500	112.0
87	00NS01DGFS59	600815	04-JUN-86	0.01500	38.0
88	00NS01DGFS59	600831	04-JUN-86	0.02900	73.0
89	10NB01BTFS03	600968	13-JUN-86	0.03200	80.0
90	10NB01BTFS03	600969	13-JUN-86	0.02600	65.0
91	01NF02YOFS19	601100	12-JUN-86	0.02700	68.0
92	01NF02YOFS19	601101	12-JUN-86	0.02600	65.0
93	01NS01DEFS14	601977	25-SEP-86	0.03100	77.0
94	01NS01DEFS14	601978	25-SEP-86	0.03800	95.0
95	01NB01BUFS02	601979	25-SEP-86	0.04200	105.0
96	10NB01BQFS06	602346	24-OCT-86	0.04100	103.0
97	01NB01BUFS02	602347	24-OCT-86	0.04000	100.0
98	01NF02YOFS18	602378	23-OCT-86	0.02400	60.0
99	01NF02YOFS18	602379	23-OCT-86	0.02400	60.0
100	01NF02YOFS18	602380	23-OCT-86	0.02000	50.0
101	10PE01CDFD03	700492	20-MAY-87	0.04200	106.0
102	10PE01CDFS03	700493	20-MAY-87	0.03500	88.0
103	10PE01CDFS03	700494	20-MAY-87	0.04200	105.0
104	10NB01BCFS01	700663	25-MAY-87	0.04400	110.0
105	10NB01BCFS01	700664	25-MAY-87	0.02100	53.0
106	10NB01BCFD01	700665	25-MAY-87	0.04300	108.0
107	00NS01DOFD10	701148	18-JUN-87	0.05300	133.0
108	00NS01DOFS10	701149	18-JUN-87	0.04300	108.0
109	00NS01DOFS10	701150	18-JUN-87	0.05700	143.0
110	00NF02YOFD22	701216	17-JUN-87	0.02200	55.0
111	00NF02YOFS22	701217	17-JUN-87	0.02300	58.0
112	00NF02YOFS22	701218	17-JUN-87	0.02000	50.0

0	1 STN	2 SAMPLE	3 SDATE	4 HCB	5 % REC
113	10PE01CCFD56	702552	17-SEP-87	0.03100	78.0
114	10PE01CCFD56	702553	17-SEP-87	0.03400	85.0
115	10NB01BCFD01	702786	05-OCT-87	0.03100	78.0
116	10NB01BCFS01	702787	05-OCT-87	0.03900	98.0
117	10NB01BCFS01	702788	05-OCT-87	0.03800	95.0
118	00NF02YDFD22	703060	22-OCT-87	0.03400	85.0
119	00NF02YDFS22	703061	22-OCT-87	0.03400	85.0
120	00NF02YDFS22	703062	22-OCT-87	0.04800	120.0
121	00NS01DDFD10	703139	29-OCT-87	0.03200	80.0
122	00NS01DDFD10	703140	29-OCT-87	0.04200	105.0
123	00NS01DDFS10	703142	29-OCT-87	0.03000	75.0
124	10PE01CCFD56	B00623	19-MAY-88	0.01000	103.0
125	10PE01CCFS56	B00624	19-MAY-88	0.00600	56.0
126	10NB01BUFS03	B00745	30-MAY-88	0.01000	107.0
127	10NB01BUFS03	B00746	30-MAY-88	0.01000	109.0
128	10NB01BUFD03	B00748	30-MAY-88	0.01000	107.0
129	01NS01EEFD52	B01074	15-JUN-88	0.01000	110.0
130	01NS01EEFS52	B01075	15-JUN-88	0.01000	100.0
131	01NS01EEFS52	B01076	15-JUN-88	0.01100	113.0
132	05NF02YEFS01	B01137	15-JUN-88	0.01000	104.0
133	05NF02YEFS01	B01138	15-JUN-88	0.01000	95.0
134	05NF02YEFD01	B01140	15-JUN-88	0.01000	106.0
135	10NB01BUFD03	B02061	19-SEP-88	0.00900	95.0
136	10NB01BUFS03	B02062	19-SEP-88	0.00940	102.0
137	10NB01BUFS03	B02063	19-SEP-88	0.01060	112.0
138	10PE01CBFD18	B02111	21-SEP-88	0.00700	65.0
139	10PE01CBFS18	B02112	21-SEP-88	0.00700	68.0
140	10PE01CBFS18	B02113	21-SEP-88	0.00700	65.0
141	01NS01EDFD62	B02598	19-OCT-88	0.01000	97.0
142	01NS01EDFS62	B02599	19-OCT-88	0.01000	100.0
143	01NS01EDFS62	B02600	19-OCT-88	0.00900	88.0
144	01NF02YAFS06	B02710	25-OCT-88	0.01100	116.0
145	01NF02YAFS06	B02711	25-OCT-88	0.00900	99.0
146	01NF02YAFD06	B02713	26-OCT-88	0.01000	101.0
147	10PE01CEFD83	900664	06-JUN-89	0.00800	84.8
148	10PE01CEFS83	900665	06-JUN-89	0.00800	84.4
149	10PE01CEFS83	900666	06-JUN-89	0.00900	96.3
150	10PE01CEFD83	902379	03-OCT-89	0.00900	93.6
151	10PE01CEFS83	902380	03-OCT-89	0.00800	83.2
152	10PE01CEFS83	902381	03-OCT-89	0.01000	104.0
153	00NF02ZMFS89	905595	14-AUG-89	0.00110	40.0
154	00NF02ZMFS89	905596	14-AUG-89	0.00232	86.0
155	00NF02ZMFD89	905597	14-AUG-89	0.00139	56.0
156	00NF02ZMFS92	905601	14-AUG-89	0.00182	64.0
157	00NF02ZMFS92	905602	14-AUG-89	0.00139	49.0
158	00NF02ZMFD92	905603	14-AUG-89	0.00251	93.0
159					
160	INTERLAB QC				
161	AND UNKNOWNS				
162					
163	50NB00000000	100671	15-MAY-81	0.21800	?
164	51ON00000000	202871	24-JAN-83	0.05400	?
165	51ON00000000	202872	24-JAN-83	0.03700	?
166	51ON00000000	202873	24-JAN-83	0.00500	?
167	51ON00000000	202874	24-JAN-83	0.00400	?
168	00ON00000000	202875	24-JAN-83	0.05000	?

0	1 STN	2 SAMPLE	3 SDATE	4 HCB	5 % REC
169	00ON00000000	202876	24-JAN-83	0.03600	?
170	00ON00000000	202877	24-JAN-83	0.01700	?
171	00ON00000000	202878	24-JAN-83	L.002	?
172	00ON00000000	202879	24-JAN-83	0.00700	?
173	00ON00000000	202880	24-JAN-83	0.00500	?
174	53NF02ZMFS04	301165	20-OCT-82	0.03200	?